GMP/15-SEV-1
Volume 1 of 3

CHEVROLET

Spark Electric Vehicle

GM

SERVICE MANUAL

INCLUDES: General Information, Body Hardware and Trim, Body Repair, Body Systems, Brakes, Diagnostic Overview, Starting Point, and Programming, Driveline/Axle

2015

DANGER

Danger: In order to reduce the chance of death, personal injury and/or property damage, carefully observe the instructions that follow:

The service manuals of General Motors are intended for use by professional, qualified technicians. Attempting repairs or service without the appropriate training, tools, and equipment could cause death or injury to you or others. This could also damage the vehicle, or cause the vehicle to operate improperly.

Proper vehicle service and repair are important to the safety of the service technician and to the safe, reliable operation of all motor vehicles. If you need to replace a part, use the same part number or an equivalent part. Do not use a replacement part of lesser quality.

The service procedures we recommend and describe in this service manual are effective methods of performing service and repair. Some of the procedures require the use of tools that are designed for specific purposes.

Accordingly, any person who intends to use a replacement part, a service procedure, or a tool that is not recommended by General Motors, must first establish that there is no jeopardy to personal safety or the safe operation of the vehicle.

This manual contains various "Dangers", "Warnings" and "Cautions" that you must observe carefully in order to reduce the risk of personal injury during service or repair. Improper service or repair may damage the vehicle or render the vehicle unsafe. These "Dangers", "Warnings" and "Cautions" are not exhaustive. General Motors can not possibly warn of all the potentially hazardous consequences of your failure to follow these instructions.

This manual covers service procedures to vehicles that are equipped with a Supplemental Inflatable Restraint. Refer to the "Warnings" in Dangers, Warnings and Cautions in Supplemental Inflatable Restraint. Refer to Supplemental Inflatable Restraint component and wiring location views in Supplemental Inflatable Restraint before performing a service on or around Supplemental Inflatable Restraint components or wiring. Failure to follow these "Dangers", "Warnings" and "Cautions" could cause air bag deployment, personal injury, or otherwise unnecessary Supplemental Inflatable Restraint repairs.

In order to help avoid accidental air bag deployment and personal injury, whenever you service a vehicle that requires repair of the Supplemental Inflatable Restraint and another vehicle system, we recommend that you first repair the Supplemental Inflatable Restraint, then go on to the other system.

2015 Chevrolet Spark EV Service Manual

Volume 1

This manual provides information on the diagnosis, the service procedures, the adjustments, and the specifications for the 2015 Chevrolet Spark EV.

The technicians who understand the material in this manual and in the appropriate Dealer Service Bulletins better serve the vehicle owners.

When this manual refers to a brand name, a part number, or a specific tool, you may use an equivalent product in place of the recommended item. All information, illustrations, and specifications in this manual are based on the latest product information available at the time of publication approval. General Motors LLC reserves the right to make changes at any time without notice.

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If you find an error in a GM Service manual, or if you have a suggestion about a GM service manual, we want to hear from you.

When calling, be prepared with the following information:

- Your name
- The name of your dealership
- The phone number of your dealership
- The model year and the vehicle line
- The publication part number, if present
- The vehicle identification number of the vehicle on which you are working
- The service category and page numbers
- Any applicable electronic information element identification numbers
- A descriptive explanation of your concern

The GM service manual phone personnel will respond to your concerns in the following ways:

- By delivering your concern to the author of the information
- By eliciting a response from the author
- By supplying you with an answer to your concerns

For paper manual users: The GM service manual phone personnel will also explain how to send in examples or marked-up pages.

For Electronic Manual users: Be prepared to provide any applicable identification numbers pertaining to the electronic information in question.

The GM service manual comment telephone numbers do not provide technical assistance. For technical assistance, contact your regular technical assistance source.

United States and Canada General Motors Dealer Employees

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You may call Monday through Saturday, 8:00 a.m.– 8:00 p.m. Eastern Time. In order to send a fax, use the following number: 1-248-285-3045.

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United States and Canadian Vehicle Owner/Operator

Vehicle owners or operators are encouraged to address their comments and concerns to the applicable Customer Assistance Center. The phone number and address of the Customer Assistance Center are in the Owner's Manual.

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Dangers, Warnings, and Cautions

Definition of Danger, Warning, Caution, and Note

The diagnosis and repair procedures in a GM Service Manual contain both general and specific Dangers, Warnings, Cautions, Notes or Importants. GM is dedicated to the presentation of service information that helps the technician to diagnose and repair the systems necessary for the proper operation of the vehicle, however, certain procedures may present a hazard to the technician if they are not followed in the recommended manner . Dangers, Warnings, Cautions and Notes or Importants are elements designed to prevent these hazards, however, not all hazards can be foreseen. This information is placed at strategic locations within the service manual. This information is designed to prevent the following from occurring:

- Serious bodily injury or death to the technician
- Damage to the vehicle
- Unnecessary vehicle repairs
- Unnecessary component replacement
- Improper repair or replacement of vehicle components.
- Any warning or caution that appears in this service category is referenced from the individual service categories.

DANGER Defined

When encountering a DANGER, you will be asked to take a necessary action or not to take a prohibited action. If a DANGER is not heeded, the following consequences may occur:

- Serious bodily injury or death to the technician
- Serious bodily injury or death to other technicians in the workplace area

WARNING Defined

When encountering a WARNING, you will be asked to take a necessary action or not to take a prohibited action. If a WARNING is not heeded, the following consequences may occur:

- Serious bodily injury to the technician
- Serious bodily injury to other technicians in the workplace area
- Serious bodily injury to the driver and/or passenger(s) of the vehicle, if the vehicle has been improperly repaired

CAUTION Defined

CAUTIONS call special attention to a necessary action or to a prohibited action. If a CAUTION is not heeded, the following consequences may occur:

- Damage to the vehicle
- Unnecessary vehicle repairs
- Unnecessary component replacement
- Improper operation or performance of the system or component under repair
- Damage to any systems or components which are dependent upon the proper operation of the system or component under repair
- Improper operation or performance of any systems or components which are dependent upon the proper operation or performance of the system or component under repair
- Damage to fasteners, basic tools, or special tools
- The leakage of coolant, lubricant, or other vital fluids

NOTE or IMPORTANT Defined

NOTE and IMPORTANT statements emphasize a necessary characteristic of a diagnostic or repair procedure. NOTE or IMPORTANT statements are designed to do the following:

- Clarify a procedure
- Present additional information for accomplishing a procedure
- Give insight into the reason or reasons for performing a procedure in the manner recommended
- Present information that will help to accomplish a procedure in a more effective manner
- Present information that gives the technician the benefit of past experience in accomplishing a procedure with greater ease

Approved Equipment for Collision Repair Warning

Warning: To avoid personal injury when exposed to welding flashes or to galvanized (Zinc Oxide) metal toxic fumes while grinding/cutting on any type of metal or sheet molded compound, you must work in a properly ventilated area, wearing an approved respirator, eye protection , earplugs, welding gloves, and protective clothing.

Assistant Driving Warning

Warning: An assistant should drive the vehicle while the technician checks for the location of the reported condition. Otherwise, personal injury could result.

Batteries Produce Explosive Gases Warning

Warning: Batteries produce explosive gases. Batteries contain corrosive acid. Batteries supply levels of electrical current high enough to cause burns. Therefore, in order to reduce the risk of personal injury while working near a battery, observe the following guidelines:

- ***Always shield your eyes.***
- ***Avoid leaning over the battery whenever possible.***
- ***Do not expose the battery to open flames or sparks.***

- *Do not allow battery acid to contact the eyes or the skin.*
  - *Flush any contacted areas with water immediately and thoroughly.*
  - *Get medical help.*

Battery Disconnect Warning

Warning: Unless directed otherwise, the ignition must be OFF with the key removed, and all electrical loads must be OFF before servicing any electrical component. Disconnect the negative battery cable to prevent an electrical spark should a tool or equipment come in contact with an exposed electrical terminal. Failure to follow these precautions may result in personal injury and/or damage to the vehicle or its components.

For Vehicles equipped with OnStar® (UE1) with Back Up Battery:

The Back Up Battery is a redundant power supply to allow limited OnStar® functionality in the event of a main vehicle battery power disruption to the VCIM (OnStar®module). Do not disconnect the main vehicle battery or remove the OnStar® fuse with the ignition key in any position other than OFF. Retained accessory power should be allowed to time out or be disabled (simply opening the driver door should disable retained accessory power) before disconnecting power. Disconnecting power to the OnStar® module in any way while the ignition is On or with retained accessory power activated may cause activation of the OnStar® Back-Up Battery system and will discharge and permanently damage the back-up battery. Once the Back-Up Battery is activated it will stay on until it has completely discharged. The back-up battery is not rechargeable and once activated the back-up battery must be replaced.

Brake Dust Warning

Warning: Avoid taking the following actions when you service wheel brake parts:

- *Do not grind brake linings.*
- *Do not sand brake linings.*
- *Do not clean wheel brake parts with a dry brush or with compressed air.*

Some models or aftermarket brake parts may contain asbestos fibers which can become airborne in dust. Breathing dust with asbestos fibers may cause serious bodily harm. Use a water-dampened cloth in order to remove any dust on brake parts. Equipment is available commercially in order to perform this washing function. These wet methods prevent fibers from becoming airborne.

Brake Fluid Irritant Warning

Warning: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- *Eye contact—rinse thoroughly with water.*
- *Skin contact—wash with soap and water.*
- *If ingested—consult a physician immediately.*

Brake Fluid Warning

Warning: Use only Delco Supreme 11, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT 3 brake fluid from a clean, sealed container. Do not use fluid from an open container that may be contaminated with water. Improper or contaminated fluid could result in damage to components, or loss of braking, with possible injury.

Checking Hot Transmission Fluid through Drain Plug Hole Warning

Warning: The engine must be running when the transmission fluid fill plug is removed, or excessive fluid loss will occur. Transmission fluid may be hot. Since the actual fluid level is unknown, stand clear when removing the fill plug. Have a container ready to capture any lost fluid. Do not turn the engine off with the fill plug removed, as you can be injured by hot transmission fluid being expelled out of the oil fill opening.

Collision Sectioning Warning

Warning: Sectioning should be performed only in the recommended areas. Failure to do so may compromise the structural integrity of the vehicle and cause personal injury if the vehicle is in a collision.

Cracked Window Warning

Warning: If a window is cracked but still intact, crisscross the window with masking tape in order to reduce the risk of damage or personal injury.

Defroster Outlet Warning

Warning: If broken glass falls into the defroster outlets, it can be blown into the passenger compartment and cause personal injury.

Electric Coolant Fan Warning

Warning: An electric fan under the hood can start up even when the engine is not running and can injure you. Keep hands, clothing and tools away from any underhood electric fan.

Exhaust Service Warning

Warning: In order to avoid being burned, do not service the exhaust system while it is still hot. Service the system when it is cool.

Eye Protection Warning

Warning: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury.

Glass and Sheet Metal Handling Warning

Warning: When working with any type of glass or sheet metal with exposed or rough edges, wear approved safety glasses and gloves in order to reduce the chance of personal injury.

Halogen Bulb Warning

Warning: Halogen bulbs contain gas under pressure. Handling a bulb improperly could cause it to shatter into flying glass fragments. To help avoid personal injury:

- ***Turn off the lamp switch and allow the bulb to cool before changing the bulb.***
- ***Leave the lamp switch OFF until the bulb change is complete.***
- ***Always wear eye protection when changing a halogen bulb.***
- ***Handle the bulb only by its base. Avoid touching the glass.***
- ***Keep dirt and moisture off the bulb.***
- ***Properly dispose of the used bulb.***
- ***Keep halogen bulbs out of the reach of children.***

Hood Hold-Open Device Warning

Warning: When a hood hold open device is being removed or installed, provide alternate support to avoid the possibility of damage to the vehicle or personal injury.

Moving Parts and Hot Surfaces Warning

Warning: Avoid contact with moving parts and hot surfaces while working around a running engine in order to prevent physical injury.

Parking Brake and Drive Wheels Warning

Warning: Apply the parking brake and block the drive wheels before performing this procedure in order to prevent bodily injury.

Protective Goggles and Glove Warning

Warning: Always wear protective goggles and gloves when removing exhaust parts as falling rust and sharp edges from worn exhaust components could result in serious personal injury.

R-1234yf Proper Service Procedures Warning

Warning: For personal safety, proper service procedure and refrigerant handling guidelines reference the applicable SAE standards when servicing vehicles equipped with R-1234yf refrigerant systems. Reference SAE J639, SAE J2845, SAE J2842, SAE J2843 & SAE J2851. Failure to follow these precautions may cause personal injury and/or damage to the vehicle or its components.

Radiator Cap Removal Warning

Warning: To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

Relieving Fuel Pressure Warning

Warning: Remove the fuel tank cap and relieve the fuel system pressure before servicing the fuel system in order to reduce the risk of personal injury. After you relieve the fuel system pressure, a small amount of fuel may be released when servicing the fuel lines, the fuel injection pump, or the connections. In order to reduce the risk of personal injury, cover the fuel system components with a shop towel before disconnection. This will catch any fuel that may leak out. Place the towel in an approved container when the disconnection is complete.

Repair Material Curing Warning

Warning: At least 24 hours are required for complete curing of repair material. The repair area should not be physically disturbed until after that time. Insufficient curing of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.

Road Test Warning

Warning: Road test a vehicle under safe conditions and while obeying all traffic laws. Do not attempt any maneuvers that could jeopardize vehicle control. Failure to adhere to these precautions could lead to serious personal injury and vehicle damage.

Safety Glasses and Compressed Air Warning

Warning: Wear safety glasses when using compressed air in order to prevent eye injury.

Safety Glasses Warning

Warning: Wear safety glasses in order to avoid eye damage.

Sensing and Diagnostic Module Handling Warning

Warning: Be careful when you handle a sensing and diagnostic module (SDM). Do not strike or jolt the SDM. Before applying power to the SDM:

- *Remove any dirt, grease, etc. from the mounting surface*
- *Position the SDM horizontally on the mounting surface*
- *Point the arrow on the SDM toward the front of the vehicle*
- *Tighten all of the SDM fasteners and SDM bracket fasteners to the specified torque value*

Failure to follow the correct procedure could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

Sensing and Diagnostic Module Voltage after Ignition is Turned Off Warning

Warning: The sensing and the diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for up to 1 minute after the ignition has been turned OFF and the fuse has been removed. If the airbags and pretensioners are not disconnected, do not begin service until one minute has been passed after disconnecting power to the SDM. Failure to do so may cause personal injury.

Servicing the SIR System Warning

Warning: When performing service on or around the SIR components or the SIR wiring, follow the procedures listed below in order to temporarily disable the SIR system. Failure to follow the procedures could result in the following:

- *Air bag deployment*
- *Personal injury*
- *Otherwise unneeded SIR system repairs*

SIR Deployed Inflator Modules Are Hot Warning

Warning: After deployment, the metal surfaces of the SIR component may be very hot. To help avoid a fire or personal injury:

- *Allow sufficient time for cooling before touching any metal surface of the SIR component.*
- *Do not place the deployed SIR component near any flammable objects.*

SIR Inflatable Module Deployment Outside Vehicle Warning

Warning: When you are deploying an inflator module for disposal, perform the deployment procedures in the order listed. Failure to follow the procedures in the order listed may result in personal injury.

SIR Inflator Module Disposal Warning

Warning: In order to prevent accidental deployment and the risk of personal injury, do not dispose of an undeployed inflator module as normal shop waste. Undeployed inflator modules contain substances that could cause severe illness or personal injury if their sealed containers are damaged during disposal. Use the following deployment procedures to safely dispose of an undeployed inflator module. Failure to observe the following disposal methods may be a violation of federal, state, or local laws.

SIR Inflator Module Handling and Storage Warning

Warning: When carrying an undeployed inflator module:

- *Do not carry the inflator module by the wires or connector.*
- *Make sure the air bag opening points away from you.*

When storing an undeployed inflator module:

- *Make sure the air bag opening points away from the surface on which the inflator module rests.*
- *Provide free space for the air bag to expand in case of an accidental deployment.*
- *When storing a steering column, do not rest the column with the air bag opening facing down and the column vertical. Lay the column on its side.*

Failure to observe these guidelines may result in personal injury.

SIR Seatbelt Pretensioner Handling Warning

Warning: When carrying an undeployed inflatable restraint seat belt retractor pretensioner:

- *Do not carry the seat belt pretensioner by the seat belt webbing or pigtail connector, if equipped.*
- *Carry the seat belt pretensioner by the housing, keeping hands and fingers away from the seat belt webbing.*
- *Make sure the opening, from which the seat belt webbing extends, faces downward and the seat belt webbing hangs freely.*

Failure to observe these guidelines may result in personal injury.

SIR Warning

Warning: This vehicle is equipped with a Supplemental Inflatable Restraint (SIR) System. Failure to follow the correct procedure could cause the following conditions:

- ***Air bag deployment***
- ***Personal injury***
- ***Unnecessary SIR system repairs***

In order to avoid the above conditions, observe the following guidelines:

- ***Refer to Master Electrical Components List in order to determine if you are performing service on or near the SIR components or the SIR wiring.***
- ***If you are performing service on or near the SIR components or the SIR wiring, disable the SIR system. Refer to Disabling the SIR System.***

Torque-to-Yield Fastener Warning

Warning: This vehicle is equipped with torque-to-yield or single use fasteners. Install a NEW torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fasteners could cause damage to the vehicle, component, or bodily injury.

Work Stall Test Warning

Warning: One or more of the following guidelines may apply when performing specific required tests in the work stall:

- ***When a test requires spinning the drive wheels with the vehicle jacked up, adhere to the following precautions:***
  - ***Do not exceed 56 km/h (35 mph) when spinning one drive wheel with the other drive wheel stopped. This limit is necessary because the speedometer indicates only one-half the actual vehicle speed under these conditions. Personal injury may result from excessive wheel spinning.***
  - ***If all of the drive wheels are spinning at the same speed, do not exceed 112 km/h (70 mph). Personal injury may result from excessive wheel spinning.***
  - ***All persons should stay clear of the rotating components and the balance weight areas in order to avoid possible personal injury.***
  - ***When running an engine in the repair stall for an extended period of time, use care not to overheat the engine and the transmission.***
- ***When a test requires jacking up the vehicle and running with the wheels and brake rotors removed, adhere to the following precautions:***
  - ***Support the suspension at normal ride height.***
  - ***Do not apply the brake with the brake rotors removed.***
  - ***Do not place the transmission in PARK with the drive axles spinning.***
  - ***Turn Off the ignition in order to stop the powertrain components from spinning.***
- ***When running an engine in the work stall, use the exhaust removal system to prevent breathing dangerous gases.***

Air Conditioning Compressor Support Caution

Caution: Ensure the air conditioning compressor is supported by a table or work area sturdy enough to handle the weight. Do not use the hoses to support the compressor. Using the compressor hoses to bear the weight of the compressor may damage the air conditioning compressor/hoses and in turn may cause a refrigerant leak. The hoses are not designed to support the weight of the air conditioning compressor.

Air in the Power Steering System Caution

Caution: If the power steering system has been serviced, an accurate fluid level reading cannot be obtained unless air is bled from the steering system. The air in the fluid may cause pump cavitation noise and may cause pump damage over a period of time.

Avoid Damage to Grid Lines Caution

Caution: If you use a razor blade or other sharp tool in order to remove the adhesives or foreign objects from the inside of the rear window, use the blade carefully. Damage to the grid lines may result.

Belt Dressing Caution

Caution: Do not use belt dressing on the drive belt. Belt dressing causes the breakdown of the composition of the drive belt. Failure to follow this recommendation will damage the drive belt.

Brake Caliper Caution

Caution: Support the caliper with a piece of wire to prevent damage to the brake line.

Brake Fluid Damage to Electrical Connections Caution

Caution: Brake fluid will damage electrical connections and painted surfaces. Use shop cloths, suitable containers, and fender covers to prevent brake fluid from contacting these areas. Always re-seal and wipe off brake fluid containers to prevent spills.

Brake Fluid Effects on Paint and Electrical Components Caution

Caution: Avoid spilling brake fluid onto painted surfaces, electrical connections, wiring, or cables. Brake fluid will damage painted surfaces and cause corrosion to electrical components. If any brake fluid comes in contact with painted surfaces, immediately

flush the area with water. If any brake fluid comes in contact with electrical connections, wiring, or cables, use a clean shop cloth to wipe away the fluid.

Catalytic Converter Movement Caution

Caution: To prevent internal damage to the flexible coupling of the catalytic converter assembly, the converter must be supported. The vertical movement at the rear of the catalytic converter assembly must not exceed 6 degrees up or down.

Clearcoat/Ultraviolet Screeners Caution

Caution: Removing more than 0.5 mils of the clearcoat can result in early paint failure. The clearcoat contains ultraviolet screeners. Do not finesse sand more than what is required to remove the defect.

Clutch Actuator Cylinder Mounting Sleeve Caution

Caution: Use a mounting sleeve when installing the clutch actuator cylinder to the transmission. The transmission input shaft has sharp edges and can damage the clutch actuator cylinder. Failure to follow this caution may cause a leak and damage to the clutch actuator cylinder.

Clutch Hydraulic System Lubricant Caution

Caution: Do not use mineral or paraffin-base oil in the clutch hydraulic system. These fluids may damage the rubber parts in the cylinders.

Component Fastener Tightening Caution

Caution: Replacement components must be the correct part number for the application. Components requiring the use of the thread locking compound, lubricants, corrosion inhibitors, or sealants are identified in the service procedure. Some replacement components may come with these coatings already applied. Do not use these coatings on components unless specified. These coatings can affect the final torque, which may affect the operation of the component. Use the correct torque specification when installing components in order to avoid damage.

Compressed Air Should Not Exceed 98 kPa (14 psi) Caution

Caution: When using compressed air to remove components, air pressure should not exceed 98 kPa (14 psi).

Drive Axle Caution

Caution: Support the lower control arms in the normal horizontal position in order to avoid damage to the drive axles. Do not operate the vehicle in gear with the wheels hanging down at full travel.

Engine Coolant Thermostat Housing Caution

Caution: Use care when performing this procedure. Use of excessive force may damage the coolant thermostat.

Engine Lifting Caution

Caution: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal, or the crankshaft pulley. Lifting the engine in an unapproved manner may cause component damage.

Engine Mounting Caution

Caution: Broken engine mountings can cause misalignment of certain drive-train components. Misalignment of drive-train components causes eventual destruction of the drive-train components.

If one engine mount breaks, the rest of the engine mounts will have increased stress put on them. This could cause the rest of the engine mounts to break.

Exterior Trim Emblem Removal Caution

Caution: Use a plastic, flat-bladed tool to prevent paint damage when removing an emblem/name plate.

Fastener Caution

Caution: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Do not use paints, lubricants, or corrosion inhibitors on fasteners, or fastener joint surfaces, unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems. When using fasteners that are threaded directly into plastic, use extreme care not to strip the mating plastic part(s). Use hand tools only, and do not use any kind of impact or power tools. Fastener should be hand tightened, fully seated, and not stripped.

Filling the Master Cylinder Caution

Caution: When filling the master cylinder, use only Delco Supreme 11, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT 3 brake fluid. Do not use a container which has been used for petroleum based fluids, or a container which is wet with water. Petroleum based fluids will cause swelling and distortion of rubber parts in the hydraulic brake system, and water will mix with brake fluid, lowering the boiling point. Keep all fluid containers capped to prevent contamination.

Flex Decoupler Caution

Caution: Do not over-flex or damage the flex joint when moving the flex joint from the normal mounting position.

HVAC Module Drain Tube Caution

Caution: Always ensure the HVAC module drain tube is properly installed and secure following a repair. Residual moisture/water can collect inside the HVAC module. The residual moisture or water should not contact electrical modules, electrical connections, wiring, cables or carpeting. Use clean and absorbent shop clothes to protect these components while removing or installing the HVAC module drain tube and/or HVAC module. Moisture/water is a by-product of normal A/C system operation and can result in interior odors or corrosion/damage to electrical components.

Ignition OFF When Disconnecting Battery Caution

Caution: Always turn the ignition OFF when connecting or disconnecting battery cables, battery chargers, or jumper cables. Failing to do so may damage the Powertrain Control Module (PCM) or other electronic components.

Installing Hoses without Twists or Bends Caution

Caution: The inlet and outlet hoses must not be twisted during installation. Do not bend or distort the inlet or outlet hoses to make installation easier. Failure to follow these procedures could result in component damage.

Liftgate Assist Rod Caution

Caution: Apply pressure only at the end of the liftgate/hood assist rod that you are removing or attaching. Do NOT apply pressure to the middle of the rod because damage or bending will result.

Power Steering Hose Disconnected Caution

Caution: Do not start the vehicle with any power steering gear inlet or outlet hoses disconnected. When disconnected, plug or cap all openings of components. Failure to do so could result in contamination or loss of power steering fluid and damage to the system.

Refrigerant Pressure During Testing Caution

Caution: Leak detection shall only be done with the refrigerant that is specified for the system. Do not attempt to increase pressure of the A/C refrigerant system with shop air or another type of refrigerant. Failure to follow the above guidelines could result in damage to the vehicle or its components.

Steering Column in Lock Position Caution

Caution: With wheels of the vehicle facing straight ahead, secure the steering wheel utilizing steering column anti-rotation pin, steering column lock, or a strap to prevent rotation. Locking of the steering column will prevent damage and a possible malfunction of the SIR system. The steering wheel must be secured in position before disconnecting the following components:

- The steering column
- The steering shaft coupling
- The intermediate shaft(s)

After disconnecting these components, do not rotate the steering wheel or move the front tires and wheels. Failure to follow this procedure may cause the SIR coil assembly to become un-centered and cause possible damage to the SIR coil. If you think the SIR coil has became un-centered, refer to your specific SIR coil's centering procedure to re-center SIR Coil.

Steering Wheel in the Full Turn Position Caution

Caution: Do not hold the steering wheel in the full turn position longer than 5 seconds, as damage to the steering pump may result.

Steering Wheel Straight and Column Locked Caution

Caution: With wheels of the vehicle facing straight ahead, secure the steering wheel utilizing steering column anti-rotation pin, steering column lock, or a strap to prevent rotation. Locking of the steering column will prevent damage and a possible malfunction of the SIR system. The steering wheel must be secured in position before disconnecting the following components:

- The steering column
- The intermediate shaft(s)
- The steering gear

After disconnecting these components, do not rotate the steering wheel or move the front tires and wheels. Failure to follow this procedure may cause the SIR coil assembly to become un-centered and cause possible damage to the SIR coil. If you think the SIR coil has became un-centered, refer to your specific SIR coil's centering procedure to re-center SIR Coil.

Test Probe Caution

Caution: Do not insert test equipment probes (DMM etc.) into any connector or fuse block terminal. The diameter of the test probes will deform most terminals. A deformed terminal will cause a poor connection, which will result in a system failure. Always use the J-35616-F GM Approved Terminal Release Tool Kit in order to front probe terminals. Do not use paper clips or other substitutes to probe terminals.

When using the J-35616-F GM Approved Terminal Release Tool Kit , ensure the terminal test adapter choice is the correct size for the connector terminal. Do not visually choose the terminal test adapter because some connector terminal cavities may appear larger than the actual terminal in the cavity. Using a larger terminal test adapter will damage the terminal. Refer to the J-35616-F GM Approved Terminal Release Tool Kit label on the inside of the J-35616-F GM Approved Terminal Release Tool Kit for the correct adapter along with the connector end view for terminal size.

Three-Way Catalytic Converter Damage Caution

Caution: In order to avoid damaging the replacement three-way catalytic converter, correct the engine misfire or mechanical fault before replacing the three-way catalytic converter.

Torque-to-Yield Fastener Caution

Caution: This vehicle is equipped with torque-to-yield or single use fasteners. Install a NEW torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component.

Using Proper Power Steering Fluid Caution

Caution: When adding fluid or making a complete fluid change, always use the proper power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

Vehicle Lifting and Jacking Caution

Caution: Perform the following steps before beginning any vehicle lifting or jacking procedure:

- Remove or secure all of the vehicle contents in order to avoid any shifting or any movement that may occur during the vehicle lifting or jacking procedure.
- The lifting equipment or the jacking equipment weight rating must meet or exceed the weight of the vehicle and any vehicle contents.
- The lifting equipment or the jacking equipment must meet the operational standards of the lifting equipment or jacking equipment manufacturer.
- Perform the vehicle lifting or jacking procedure on a clean, hard, dry, level surface.
- Perform the vehicle lifting or jacking procedure only at the identified lift points. DO NOT allow the lifting equipment or jacking equipment to contact any other vehicle components.

Failure to perform the previous steps could result in damage to the lifting equipment or the jacking equipment, the vehicle, and/or the vehicle contents.

Windshield Installation Caution

Caution: Do not use spacers when installing a windshield. The stress caused by the spacers may damage the windshield.

Section 1

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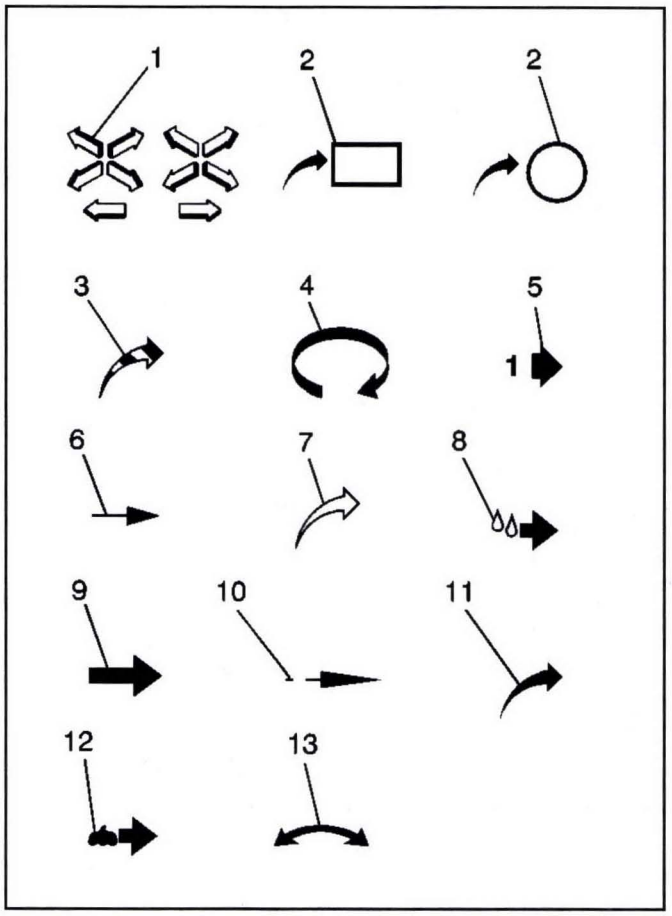
General Information

Introduction

Arrows and Symbols

This service manual uses various symbols in order to describe different service operations.



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Legend

(1) Front of Vehicle
(2) View Detail
(2) View Detail
(3) Ambient Air Mixed with Another Gas or Indicate Temperature Change
(4) Motion or Direction
(5) View Angle
(6) Dimension (1:2)
(7) Ambient/Clean Air Flow or Cool Air Flow
(8) Lubrication Point– Oil or Fluid
(9) Task Related
(10) Sectioning (1:3)
(11) Gas Other Than Ambient Air or Hot Air Flow
(12) Lubrication Point– Grease or Jelly
(13) Multidirectional Arrow

Acronyms and Units

Acronyms

Acronym	Meaning	Definition
2WD	Two-Wheel Drive	Indicates that a vehicle has 2 driven wheels OR that a 4WD vehicle uses only 2 wheels for propulsion. So it can be the description of a vehicle configuration OR the operational mode of the drivetrain.
4WD	Four-Wheel Drive	Four-wheeled vehicle with a drivetrain that allows all four wheels to receive power from the engine simultaneously which provides better control on various surfaces. Can be used to describe the configuration of the vehicle OR as the operational mode of the drivetrain. 4WD vehicles usually can turn 2 wheels off to be in a 2WD mode. See also AWD.
A/C	Air Conditioning	The cooling and dehumidification of indoor air for thermal comfort.
A/D	Analog to Digital	Used in context of converting electrical analog signals to digital signals.
ABS	Antilock Braking System	System on motor vehicles which prevents the wheels from locking while braking which helps the driver maintain control in heavy braking conditions.
AC	Alternating Current	An electrical current whose magnitude and direction vary cyclically.
AGM	Absorbent Glass Mat	the AGM battery uses a very absorbent micro fiberglass material to trap the gas generated during discharge and recharge.
AM	Amplitude Modulation	Method of impressing data onto an alternating-current (AC) carrier waveform.
APP	Accelerator Pedal Position	A pedal that controls the throttle valve.
AWD	All-Wheel Drive	All-wheel-drive systems are designed to function on all types of surfaces, both on- and off-road, and most of them cannot be switched off. This can also be called full-time four wheel drive. See also 4WD.
AWG	American Wire Gauge	American wire gauge is a standardized wire gauge system used since 1857 predominantly in the United States for the diameters of round, solid, nonferrous, electrically conducting wire. E.g. a wire of AWG10 has a diameter of 2.588mm, AWG20 corresponds to a diameter of 0.812mm.
B+	Battery Positive Voltage	The electrical potential on the positive terminal of the battery.
BARO	Barometric Pressure	Atmospheric pressure as measured by a barometer.
BCM	Body Control Module	This module supplies vehicle occupants with visual and audible information and controls various vehicle functions,
BECM	Battery Energy Control Module	Control module used to regulate the battery voltage.
BPP	Brake Pedal Position	Position of the foot pedal that moves a piston in the master brake cylinder.
CAN	Controller Area Network	Serial data connection between control modules by Bosch
CCM	Chassis Control Module	The module that controls various vehicle functions on the Chassis, like Engine/Trans Mount, Active Grille Air Shutter, Load Leveling, etc…
CD	Compact Disc	A small optical disk on which data such as music, text, or graphic images is digitally encoded.
CNG	Compressed Natural Gas	This a substitute for gasoline or diesel fuel. It is made by compressing natural gas (which is mainly composed by methane (CH4), in a percentage range of 70% to 98%)
CO	Carbon Monoxide	This is a product of the incomplete combustion of carbon-containing compounds, at room temperature this is a gas. It consists of one carbon atom covalently bonded to one oxygen atom.
CO2	Carbon Dioxide	Chemical compound composed of two oxygen atoms covalently bonded to a single carbon atom.
CPA	Connector Position Assurance	Part of an electrical connector that prevents the connector from moving out of its socket. Usually needs to be pressed to unlock the connector when disconnecting it.

Acronyms (cont'd)

Acronym	Meaning	Definition
CPP	Clutch Pedal Position	A lever operated with the foot that controls the coupling that connects or disconnects driving and driven parts of a driving mechanism.
CV	Constant Velocity	Used in conjunction with CV joints, which connect two shafts at an angle while both shafts always have the same rotational speed without variations.
CVT	Continuously Variable Transmission	A transmission in which the ratio of the rotational speeds of two shafts, as the input shaft and output shaft of a vehicle or other machine, can be varied continuously within a given range, providing an infinite number of possible ratios which improves fuel economy.
D	Drive	D on the transmission gear selector lever.
DAB	Digital Audio Broadcast	Technology for broadcasting of audio using digital radio (carries information via digital signal) transmission.
DC	Direct Current	Continuous current, constant flow of electric charge.
DLC	Data Link Connector	This is an electronic connector typically located underneath the driver's side dashboard, just above the pedals. The connector has 16 pins.
DMM	Digital Multimeter	Electronic measuring instrument that combines several functions in one unit. The most basic instruments include an ammeter, voltmeter, and ohmmeter.
DOHC	Dual Overhead Camshaft	Dual overhead camshafts (DOHC) are higher performance engines, they produce more power, and can run at higher speeds because they allow an engine to have four valves per cylinder. Each camshaft operates two of the valves, one camshaft handles the intake valves, and one handles the exhaust valves
DPF	Diesel Particulate Filter	Device designed to remove diesel particulate matter or soot from the exhaust gas of a diesel engine.
DRL	Daytime Running Lamps	White lights mounted on the front of an automobile that automatically switch on when the key is turned and are intended for daytime use, to increase the visibility of the automobile.
DSCC	Distance Sensing Cruise Control	A type of cruise control that automatically maintains the distance between vehicles.
DSP	Digital Signal Processor	A specialized microprocessor designed specifically for digital signal processing, generally in real-time computing.
DTC	Diagnostic Trouble Code	An electronic signal stored in an automotive computer, indicating the presence of a fault detected by that computer.
DVD	DVD	A popular optical disc storage media format the size of a CD. Used mainly for movies but also for data. DVD has no spelled out version (officially it does not mean Digital Video Disc or Digital Versatile Disc, it just means DVD).
EBCM	Electronic Brake Control Module	This module contains a microprocessor and software for antilock braking system operation.
ECM	Engine Control Module	This electronic module works with a vehicle's sensors and engine control devices to insure that the engine operates at maximum efficiency and performance. It performs three vital functions. Receives electronic signals from engine sensors. Analyzes the data and makes an engine performance decision (based on the pre-set parameters within the unit). Sends an "output command" to an actuator that adjusts engine performance.
ECT	Engine Coolant Temperature	A measure of how hot or cold the fluid which flows through the engine in order to prevent its overheating, transferring the heat produced by the device to other devices that utilize or dissipate it.
EEPROM	Electrically Erasable Programmable Read-Only Memory	A non-volatile storage chip used in computers and other devices to store small amounts of volatile data, e.g. calibration tables or device configuration.
EGR	Exhaust Gas Recirculation	Is an NOx (nitrogen oxide and nitrogen dioxide) reduction technique used in most gasoline and diesel engines. EGR works by recirculating a portion of an engine's exhaust gas back to the engine cylinders.

Acronyms (cont'd)

Acronym	Meaning	Definition
EMI	Electromagnetic Interference	Electromagnetic interference (also called radio frequency interference) is a disturbance that affects an electrical circuit due to either electromagnetic conduction or electromagnetic radiation emitted from an external source.
ESD	Electrostatic Discharge	The sudden and momentary electric current that flows between two objects at different electrical potentials.
EV	Electric Vehicle	A category of vehicles that only have an electric drive system.
EVAP	Evaporative Emission	A system that controls the fuel fumes in the fuel tank.
FM	Frequency Modulation	In telecommunication this is a way to convey information over a carrier wave by varying its frequency.
FWD	Front-Wheel Drive	A form of engine/transmission layout used in motor vehicles, where the engine drives the front wheels only.
GMLAN	General Motors Local Area Network	A local-area network is a computer network covering a small geographic area, like a home or vehicle. This specific type of LAN connects several controllers inside the vehicle and was developed by General Motors.
GPS	Global Positioning System	Satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense.
GSM	Global System for Mobile Communications	Globally accepted standard for digital cellular communication.
GVW	Gross Vehicle Weight	Maximum total weight of a road vehicle or trailer that is loaded, including the weight of the vehicle itself plus fuel, passengers, cargo, and trailer tongue weight.
HD	Heavy Duty	Robust design to accommodate large work loads.
HID	High Intensity Discharge	A type of light that produces a bright light by using gas filled bulbs. (gas is usually mercury, metal halide, and high-pressure sodium) Uses very little battery power and is a very "cool" light.
HO2S	Heated Oxygen Sensor	Heated oxygen sensors have an internal heater circuit that brings the sensor up to operating temperature more quickly than an unheated sensor. An oxygen sensor must be hot (about 600–650°F) before it will generate a voltage signal. The hot exhaust from the engine will provide enough heat to bring an O2 sensor up to operating temperature.
HVAC	Heating Ventilation Air Conditioning	This system is sometimes referred to as climate control. Ventilation air ducts installed throughout a vehicle that supply conditioned air to a room through rectangular or round outlet vents.
I^2C	Inter-Integrated Circuit	Serial data connection between Integrated Circuits (microchips) inside a control module invented by Phillips
IAT	Intake Air Temperature	Temperature of the air entering intake air flow system of the engine.
ICE	Internal Combustion Engine	An engine in which the combustion of fuel and an oxidizer (typically air) occurs in a confined space called a combustion chamber.
ID	Identification	Number or Code that identifies a component or control module. Can be written on the part or be transmitted on a bus or via radio.
ISP	Internet Service Provider	A company that furnishes corporations and individual consumers with various services, mainly access to the Internet.
ISS	Input Shaft Speed	Rotational speed of the input shaft of a transmission.
LAN	Local Area Network	Standard network connection PC's.
LCD	Liquid Crystal Display	A thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector.
LED	Light Emitting Diode	Small light bulbs that fit easily into an electrical circuit they do not have a filament that will burn out, and they do not get especially hot. They are illuminated solely by the movement of electrons in a semiconductor material.
LIN	Local Interconnect Network	Computer networking bus system used within automotive network architectures. Similar to CAN, but cheaper and less powerful.
LPG	Liquefied Petroleum Gas	A mixture of mainly propane and butane, produced commercially and stored under pressure to keep it in a liquid state.

Acronyms (cont'd)

Acronym	Meaning	Definition
MAF	Mass Air Flow	The amount of air drawn into the engine
MAP	Manifold Absolute Pressure	Pressure in the engine intake system after the throttle valve referenced to a perfect vacuum.
MDI	Multiple Diagnostics Interface	A device used by GM dealers that enables a PC to communicate with the control modules in a vehicle.
MIL	Malfunction Indicator Lamp	An indicator of the internal status of a car engine.
MOST	Media Oriented Systems Transport	Serial communication bus to transmit audio and video information.
N	Neutral	A state of the transmission in which it is not engaged.
NiMH	Nickel Metal Hydride	A type of rechargeable battery that uses a hydrogen absorbing alloy for the negative electrode.
NOx	Nitrogen Oxides	Refers to any of the following oxygen compounds of nitrogen or a mixture of them. Nitric Oxide, Nitrogen dioxide, Nitrous Oxide, Dinitrogen trioxide, Dinitrogen tetroxide, Dinitrogen pentoxide.
O2	Oxygen	A colorless, odorless, tasteless, gaseous chemical element with the chemical symbol O and atomic number 8.
O2S	Oxygen Sensor	An electronic device that measures the proportion of oxygen (O2) in the gas or liquid being analyzed.
OBD	On-Board Diagnostic	A generic term referring to a vehicle's self-diagnostic and reporting capability.
OEM	Original Equipment Manufacturer	A producer that provides a product to its customers, who proceed to modify or bundle it before distributing it to their customers.
OSS	Output Shaft Speed	Rotational speed of the output shaft of a transmission.
P	Park	A state in which the transmission is set so one can leave the vehicle.
PCB	Printed Circuit Board	A thin plate on which chips and other electronic components are placed.
PCM	Powertrain Control Module	A control module that features the functions of both, the engine and the transmission control module.
PCMCIA	Personal Computer Memory Card Industry Association	An international standards body and trade association with over 100 member companies that was founded in 1989 to establish standards for Integrated Circuit cards and to promote interchangeability among mobile computers where ruggedness, low power, and small size were critical.
PIN	Personal Identification Number	A secret numeric password shared between a user and a system that can be used to authenticate the user to the system.
PPE	Personal Protective Equipment	Protective clothing, helmets, goggles, or other garment designed to protect the wearer's body from injury.
PRNDL	Park, Reverse, Neutral, Drive, Low	Park, Reverse, Neutral, Drive, Low (automatic transmission positions).
PTC	Positive Temperature Coefficient	Refers to materials that experience an increase in electrical resistance when their temperature is raised.
PTO	Power Take-Off	A splined driveshaft, usually on a tractor or truck that can be used to provide power to an attachment or separate machine. This mechanism allows implements to draw energy from the tractor's engine.
PVC	Polyvinyl Chloride	A thermoplastic copolymer.
PWM	Pulse Width Modulation	Square shaped type of signal that carries the information in the ratio between on and off times.
R	Reverse	Rearward: directed or moving toward the rear;
RAM	Random Access Memory	A type of computer data storage. It today takes the form of integrated circuits that allow the stored data to be accessed in any order.
RCT	Radiator Coolant Temperature	This is the heat intensity of the radiator coolant measured in degrees. The radiator is a part of the cooling system that removes the engine heat. Coolant is a mixture of water and antifreeze (ethylene glycol) which lowers the freezing point of the water in the coolant system, this fluid also picks up heat from the engine and transfers it to the air.

Acronyms (cont'd)

Acronym	Meaning	Definition
RDS	Radio Data System	A standard from the European Broadcasting Union for sending small amounts of digital information using conventional FM radio broadcasts.
RF	Radio Frequency	A frequency or rate of oscillation within the range of about 3 Hz and 300 GHz. This range corresponds to frequency of alternating current electrical signals used to produce and detect radio waves.
ROM	Read-Only Memory	A class of storage media used in computers and other electronic devices. Data stored in ROM cannot be modified.
RPO	Regular Production Option	A three digit/letter code given to parts, assemblies, and systems originally installed on the vehicle. These RPO codes designate options and are assigned by General Motors.
RSA	Rear Seat Audio	An auxiliary set of controls that operate the main audio system from the rear seat. Rear passengers can also operate a different media source than the front passengers.
RWD	Rear-Wheel Drive	A common engine/transmission layout in which the engine is in the front of the vehicle, but the front mid-engine, rear mid-engine and rear engine layouts are also used.
SCV	Speed Controlled Volume	The volume control is set for a desired sound level in the vehicle as the vehicle increases its speed, the sound level is adjusted.
SDM	Sensing and Diagnostic Module	The name given to air bag modules used in General Motors vehicles.
SIM	Subscriber Identity Module	Part of a removable smart card Integrated Circuit Card. This is used for mobile cellular telephone devices such as mobile computers and mobile phones. SIM cards securely store the service-subscriber key used to identify a subscriber. The SIM card allows users to change phones by simply removing the SIM card from one mobile phone and inserting it into another mobile phone or broadband telephony device.
SIR	Supplemental Inflatable Restraint	Technical term for the air bag. Air bag is a stretchable membrane, which inflates during an automobile accident to provide cushioning to the passenger's head and torso to prevent injury to the passengers.
SPI	Serial Peripheral Interface	This is an interface that enables the serial (one bit at a time) exchange of data between two devices. An SPI operates in full duplex mode. This means that data can be transferred in both directions at the same time. It is a standard bus technology like CAN or I2C.
SPS	Service Programming System	System that enables repair facilities to update the software in control modules.
SUV	Sport Utility Vehicle	A passenger vehicle which combines the towing capacity of a pickup truck with the passenger-carrying space of a minivan.
SVS	Service Vehicle Soon	Indicator lamp or symbol for a malfunction related to a vehicle component or system.
TA	Traffic Announcement	Message spoken on radio regarding the movement of vehicles or pedestrians through an area or along a route. The buttons on radios that enable this announcements are also often labeled TA.
TAC	Throttle Actuator Control	A motor which moves the engine throttle plate or valve, controlled by the engine control module. A throttle plate limits the amount of air entering a internal combustion gasoline engine.
TAP	Transmission Adaptive Pressure	The transmission control module learns each component's characteristics and adjusts fluid pressure accordingly.
TCC	Torque Converter Clutch	Resides in a torque converter to connect an engine to an automatic transmission. The clutch is applied when conditions are correct to achieve a 1:1 ratio of engine crankshaft to transmission input shaft.
TCM	Transmission Control Module	A module that controls electronic automatic transmissions. It uses sensors from the vehicle as well as data provided by the Engine Control Module to calculate how and when to change gears in the vehicle for optimum performance, fuel economy and shift quality.
TDC	Top Dead Center	The piston is in its highest position relative to the combustion chamber.

Acronyms (cont'd)

Acronym	Meaning	Definition
TIS	Techline Information System	The PC-based global dealership diagnostic software that provides the technician the ability to reference the most recent service information via the service department's computer.
TPA	Terminal Position Assurance	An additional locking mechanism inside an electric connector that holds the pins in place.
TV	Television	A telecommunication system for broadcasting and receiving moving pictures and sound over a distance.
USB	Universal Serial Bus	A type of communication bus connection between a computer and a peripheral device.
VCI	Vehicle Communications Interface	A diagnostic tool that communicates to modules of multiple communication protocols in a vehicle by converting vehicle serial data into PC serial data communication.
VIN	Vehicle Identification Number	Used by manufacturers to uniquely identify motor vehicles using 17 characters.
VSCM	Vehicle Stability Control Module	This module uses information from several sensors to detect a loss of vehicle traction, then works with the antilock brake system to apply individual brakes to help keep the vehicle on its intended path.
VSS	Vehicle Speed Sensor	Sends data regarding how fast the car is traveling at the moment of driving. It is designed to be able to record the rate at which the vehicle's crankshaft is spinning.
WOT	Wide Open Throttle	When the throttle blade or valve is at its maximum open position, allowing maximum air to enter an internal combustion gasoline engine.
WLAN	Wireless Local Area Network	Standard to transmit digital data via radio frequency.
XM	XM (Satellite Radio)	XM Satellite Radio Holdings (XM) is one of two satellite radio services in the United States and Canada. XM provides pay-for-service radio, analogous to cable television. Its service includes 73 different music channels, 39 news, sports, talk, and entertainment channels, 21 regional traffic and weather channels and 23 play-by-play sports channels (2008).
XML	Extensible Markup Language	A markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable.

Units

Unit	Meaning	Definition
m^2	Square Meter	Area
A	Ampere	Electrical
Ah	Ampere Hour	Electrical
C	Coulomb	Electrical
dBm	Decibel Meter	Electrical
dBmV	Decibel Millivolt	Electrical
mV/DIV	Millivolts per Division	Electrical
mV/s	Millivolts per Second	Electrical
Ω	Ohm	Electrical
V	Volt	Electrical
V/DIV	Volts per Division	Electrical
V/ms	Volts per Millisecond	Electrical
W	Watt	Electrical
mm^3/stroke	Cubic Millimeters per Stroke	Flow
gal/h	Gallons per Hour	Flow
g/s	grams per second	Flow

Units (cont'd)

Unit	Meaning	Definition
g/stroke	Grams per Stroke	Flow
kg/100km	Kilograms per 100 Kilometer	Flow
kg/h	Kilograms per Hour	Flow
km/L	kilometer/liter	Flow
L/100km	Liters per 100 Kilometers	Flow
L/h	Liters per Hour	Flow
L/min	Liters per Minute	Flow
MPG	Miles per Gallon	Flow
mg/s	Milligrams per Second	Flow
mg/stroke	Milligrams per stroke	Flow
ft	feet	Length
in	Inch	Length
m	Meter	Length
mi	Mile	Length
bar	Bar	Mechanical
bar/min	Bars per Minute	Mechanical
in. H2O	Inches of Water	Mechanical

Units (cont'd)

Unit	Meaning	Definition
in. H2O/s	Inches of Water per second	Mechanical
kPa/s	Kilopascals per Second	Mechanical
N	Newton	Mechanical
N•m	Newton Meter	Mechanical
Pa	Pascal	Mechanical
Pa/s	Pascals per Second	Mechanical
lb ft	Pound Foot	Mechanical
PSI	Pound-Force per Square Inch	Mechanical
Counts	Counts	Misc.
Cycles	Cycles	Misc.
dB	Decibel	Misc.
°	Degree	Misc.
°C	Degree Centigrade	Misc.
°CA	Degree Crankshaft Angle	Misc.
°F	Degree Fahrenheit	Misc.
°/s	Degree per Second	Misc.
Hz	Hertz	Misc.
kbit/s	Kilobit per second	Misc.
lx	Lux	Misc.
ppm	Parts per Million	Misc.
%	Percent	Misc.
%/min	Percents per Minute	Misc.
%/sec	Percents per Second	Misc.
Pulses	Pulses	Misc.
:1	Ratio	Misc.
RPM	Revolutions per Minute	Misc.
Steps	Steps	Misc.
W/m²	Watts per Square Meter	Misc.
g	g (Acceleration)	Movement
km/h	Kilometers per Hour	Movement
m/s	Meters per Second	Movement
m/s³	Meters per Second Cubed	Movement
m/s²	Meters per Second Squared	Movement
MPH	Miles per Hour	Movement
mm/s	Millimeters per Second	Movement
d	Day	Time
h	Hour	Time
hh:mm:ss	Hour:Minute:Second	Time
ms/DIV	Milliseconds per Division	Time
min	Minute	Time
s	Second	Time
s/DIV	Seconds per Division	Time

Units (cont'd)

Unit	Meaning	Definition
yy-mm-dd	Year-Month-Day (2 digits)	Time
yyyy-mm-dd	Year-Month-Day (4 digits, preferred)	Time
m³	Cubic Meter	Volume
gal	Gallon	Volume
L	Liter	Volume
mL	milliliters	Volume
US gal	US Gallon	Volume
US pt	US Pint	Volume
US qt	US Quart	Volume
kg	Kilogram	Weight

Customer Concern Verification Sheets

The GM Customer Concern Verification Sheets have been designed to improve communications between the service customer and the technician. The more clearly the technician understands the concern and its symptoms, the more likely the concern will be fixed right the first time.

Training

Dealers

All U.S. GM Dealers participating in the Center of Learning / GM Service Technical College (STC) Programs can enroll through the Center of Learning website at https://www.centerlearning.com. Within the website, there are individual training paths that are designed to assist in planning the training needs for each individual and their job role. Dealers who have questions about Center of Learning Training should contact the Center of Learning help desk at 1-888-748-2687. The help desk is available Monday through Friday, 8:00 am – 9:00 pm Eastern Standard Time, excluding holidays. For GM Access support, contact the GM Access Help Desk at 1-888-337-1010.

Fleets

GM Fleet customers with GM Warranty In-Shop agreements are able to participate in service technical training through the Center of Learning/GM Service Technical College (STC).

Assistance for GM fleet registered customers using GM STC training is provided by the Center of Learning help desk at 1-888-748-2687. The help desk is available Monday through Friday, 8:00 am–9:00 pm Eastern Standard Time, excluding holidays. For GM Access support, contact the GM Access Help Desk at 1-888-337-1010.

Most GM STC course materials have associated charges.

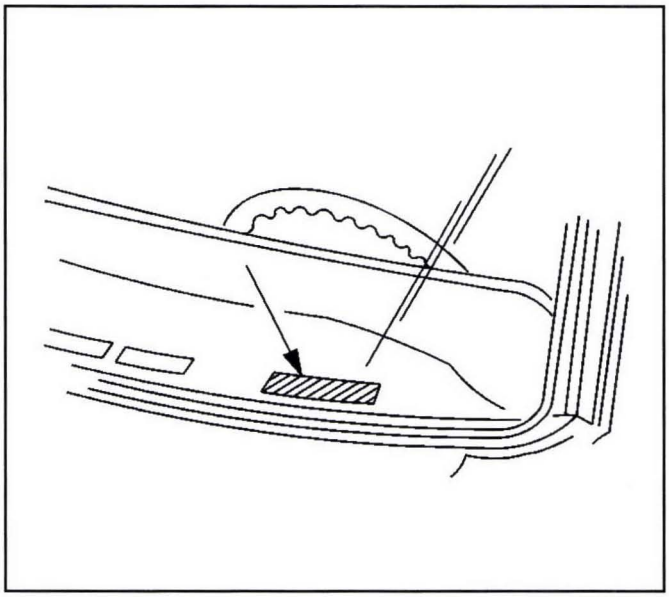
To purchase authentic GM STC Training Materials, contact the GM Training Materials Headquarters at 1-800-393-4831.

Non-GM Dealer Technicians

Technician training for non-GM dealers is available through ACDelco. This training is for ACDelco PSC and Fleet program members employed in the automotive or truck service industry.

ACDelco courses are available at approved GM STC Training Centers. Availability and schedules can be obtained by calling 1-800-825-5886 (prompt 1) or contact us via the web at www.acdelcotechconnect.com and select the Training tab. Seminars are also offered through the ACDelco Warehouse Distribution channel. Contact your Local ACDelco representative or distributor directly for more information.

Vehicle, Engine and Transmission ID and VIN Location, Derivative and Usage



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The vehicle identification number (VIN) plate is the legal identifier of the vehicle. The VIN plate is located on the upper left corner of the instrument panel (I/P) and can be seen through the windshield from the outside of the vehicle:

Vehicle, Engine and Transmission ID and VIN Location, Derivative and Usage

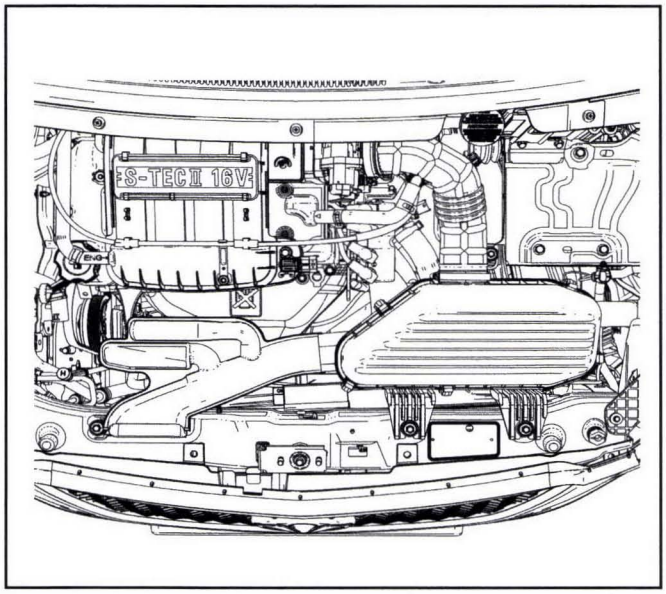
Position	Definition	Character	Description
1	Region of Build	K	Korea
2	Manufacturer	L	GM Korea Company
3	Vehicle Brand/Type	8	Chevrolet Passenger Car
4–5	Vehicle Line/Series	C/A	Chevrolet Spark LS (Manual)
		C/B	Chevrolet Spark LS (Automatic)
		C/C	Chevrolet Spark 1LT (Manual)
		C/D	Chevrolet Spark 1LT (Automatic)
		C/E	Chevrolet Spark 2LT (Manual)
		C/F	Chevrolet Spark 2LT (Automatic)
		C/K	Chevrolet Spark EV 1LT

Vehicle, Engine and Transmission ID and VIN Location, Derivative and Usage (cont'd)

Position	Definition	Character	Description
		C/L	Chevrolet Spark EV 2LT
6	Body Style	6	48 – Sedan, 4-Door, 4 Window, Hatchback
7	Restraint System	A	AR1 – Active Manual Belts, Airbag Delete
		S	AYF – Active Manual Belts, Airbags – Driver & Passenger Front (1st row), Front Seat Side (1st row) & Rear Seat Side (2nd row), Roof Side (all seating rows), Driver & Passenger knee (1st row)
8	Engine Type	9	RPO LL0 – Engine Gas, 4 Cylinder, L4, 1.2L, MFI, DOHC, FAM A/B, DCVCP
		0	RPO EN0 – Engine – None
9	Check Digit	X	Calculated by POMS
10	Model Year	F	2015
11	Plant Location	C	Changwon
12–17	Plant Sequence Number	—	Plant Sequence Number

Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label

Certification Plate Location



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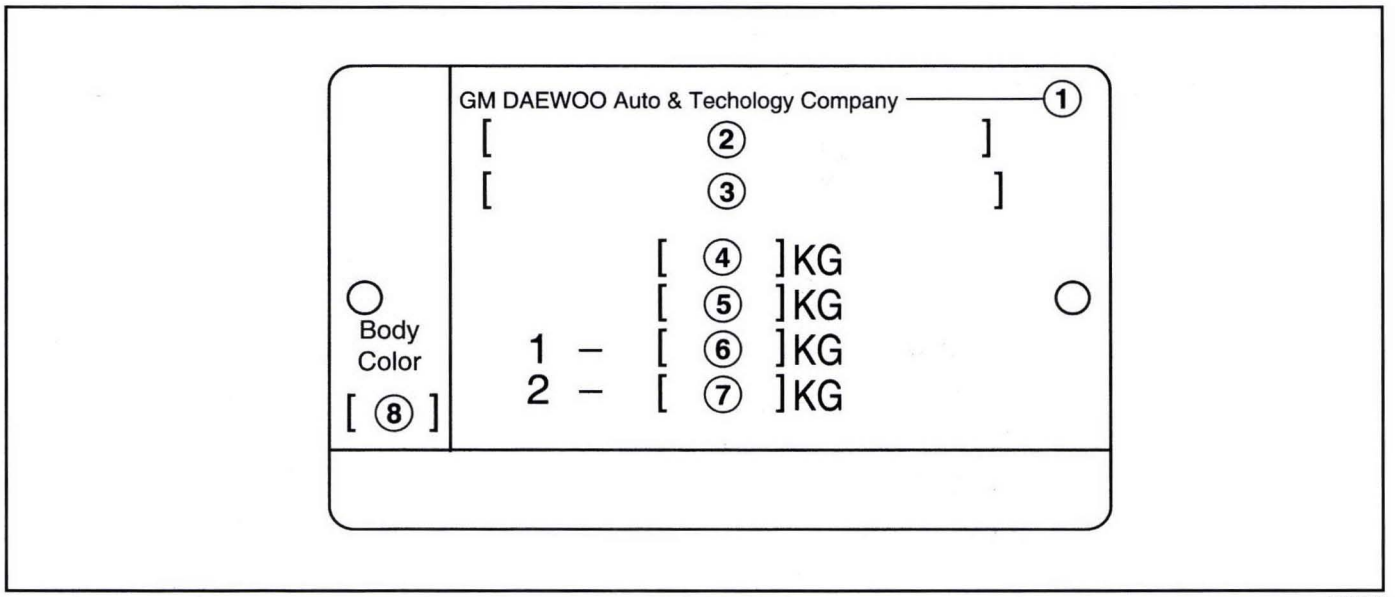
The vehicle identification number (VIN) plate is attached to the top of the front panel support.

Identification Plate Location



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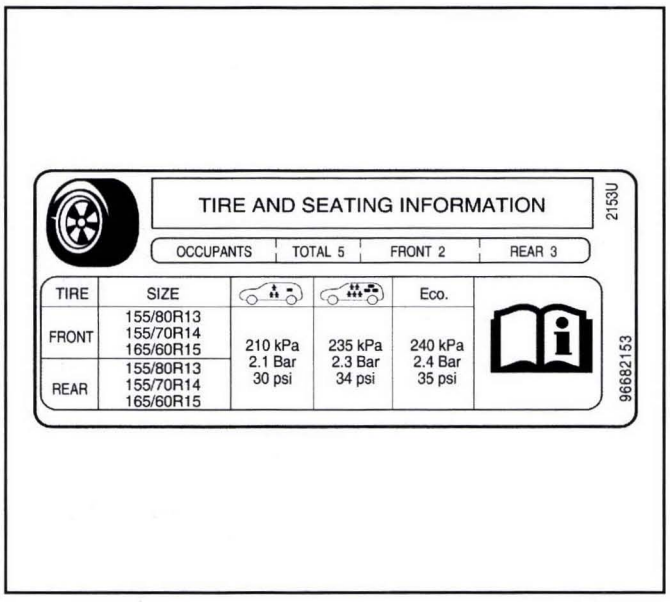
Legend

(1) Manufacturer Name
(2) Whole Vehicle Type Approval Number
(3) VIN (Vehicle Identification Number)
(4) GVW
(5) Combination Weight (GVW + Braked Trailer Weight)
(6) Maximum Permissible Axle Weight – Front
(7) Maximum Permissible Axle Weight – Rear
(8) Body Color

Tire Placard



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The tire placard label is located on the driver door and displays the following assessments:

- Tire size
- Tire pressure
  - – Front
  - – Rear
  - – Various loading conditions

RPO Code List

The following table provides the description of the Regular Production Option (RPO) codes that are available on the vehicle. The vehicle's RPO list is printed on the Service Parts Identification Label.

RPO	Description
01C	TRIM COLOR SEAT – LIGHT TITANIUM
01O	TRIM COLOR SEAT – V DK PEWTER
07R	TRIM COLOR SEAT-BLUE RAY
1AQ	TRIM COLOR DOOR PANEL – V DK PEWTER
2BV	MOLDING DOOR INTR-SWITCHBLADE SILVER MET
2HB	MOLDING DOOR INTR-BLUE RAY
37F	STEERING WHEEL COLOR – POLAR SILVER
3E3	PANEL CENTER-INSTRUMENT,BLUE RAY, PAD PRINTING
4AQ	INTERIOR TRIM – V DK PEWTER
5A7	WHEEL SPARE-NONE
5AM	ACCESSORY-CHARGE CORD SET MODE2 CHARGING - CEE 7/7 TO TYPE 1 VEH CONN
5AO	ACCESSORY-CHARGE CORD SET MODE2 CHARGING - NEMA 5 TO TYPE 1 VEH CONN
5MB	PANEL – TRIM, RIGHT REAR COMPARTMENT, SIDE

RPO	Description
5MC	PANEL – TRIM, LOAD COMPARTMENT, SIDE
9H2	FUEL TANK-(NONE)
9L3	TIRE SPARE-NONE
A91	LOCK CONTROL RIGHT REAR COMPARTMENT – TAILGATE, REMOTE CONTROLLED ELECTRONIC OPEN/ CLOSE
AAX	INTERIOR TRIM CONFIG-#18
AE3	WINDOW – POWER OPERATED, FRONT AND REAR DOOR
AFW	INTERIOR TRIM CONFIG-#48
AFX	INTERIOR TRIM CONFIG-#49
AH9	ADJUSTER FRONT SEAT – MANUAL, 2 WAY, DRIVER
AKJ	WINDSHIELD STYLE-SHADE BAND
AKP	WINDOW TYPE-SOLAR ABSORBING
AKX	WINDSHIELD TYPE-SOLAR ABSORBING
AL0	SENSOR INDICATOR-INFLATABLE RESTRAINT, FRT PASS/CHILD PRESENCE DETECTOR
AMA	SEAT REAR – SPLIT BACK, FOLDING, HEADREST
AME	LOCK CONTROL – SIDE DOOR, EMERGENCY UNLOCK, AUTOMATIC
AQ2	NET – CONVENIENCE, PACKAGE
AT3	RESTRAINT PROVISIONS – CHILD, REAR SEAT, ANCHORAGE, REINFORCED
ATR	RESTRAINT SYSTEM RR-SEAT, SHLDR, RETR, 3 POINT, 2 SHLDR
AU3	LOCK CONTROL – SIDE DOOR, ELECTRONIC
AU4	LOCK CONTROL – SIDE DOOR, ELECTRONIC, AUTOMATIC
AV5	SEAT – FRONT BUCKET, HIGH BACK
AW7	RESTRAINT SYSTEM-SEAT, INFLATABLE, DRIVER & PASS FRT, FRT SEAT SIDE & RR SEAT SIDE, ROOF SIDE
AWS	RESTRAINT – SEAT BELT TENSIONER, PASSENGER
AWT	RESTRAINT – SEAT BELT TENSIONER, DRIVER
AXJ	VEHICLE TYPE-PASSENGER CAR
AYF	RESTRAINT SYSTEM – SEAT, INFLATABLE, DRIVER AND PASSENGER FRONT, FRONT SEAT SIDE & RR SEAT SIDE, ROOF SIDE, KNEE
B30	COVERING FLOOR – CARPET
B37	COVERING – FLOOR MAT, FRONT AND REAR, AUXILIARY
B56	MOLDING ROCKER – BODY COLOR
B7S	TRAY – INTERIOR, REAR, PARCEL, PULL STRING
BTM	SWITCH-ENGINE START, KEYLESS
BTV	REMOTE START-ENGINE

RPO	Description
BXQ	ORNAMENTATION-EXTR, PLR APLQ, REVEAL, BLACK
C1E	ORNAMENTATION INTR-I/P TRAY, SWITCHBLADE SILVER MET
C1Q	ORNAMENTATION INTR-I/P TRAY, BLUE RAY
C37	HEATER-SEAT, DRIVER
C38	HEATER-SEAT, PASS
C49	DEFOGGER-RR WINDOW, ELECTRIC
C68	HVAC SYSTEM-AIR CONDITIONER FRT, AUTO, ELECTRONIC CONTROLS
C91	LAMP-INTR, ROOF, COURTESY
C99	SWITCH-INFL RST I/P MDL MAN SUPPRESSION
CBT	PROVISIONS-FAST CHARGING ACCOMMODATIONS
CD4	WIPER SYS WINDSHIELD-PULSE, VARIABLE DELAY
CD6	WIPER SYS RR WINDOW-CONTINUOUS
CKR	PLANT CODE-CHANGWON, KOREA
CT1	COUNTRY-BELGIUM
CT3	COUNTRY-GERMANY
CT4	COUNTRY-LUXEMBOURG
CT5	COUNTRY-NETHERLANDS
CT6	COUNTRY-ITALY
CT9	COUNTRY-SPAIN
CU3	COUNTRY-FRANCE
CU5	COUNTRY-SWITZERLAND
CU9	COUNTRY-UNITED KINGDOM
CW1	COUNTRY-KOREA
D31	MIRROR I/S R/V-TILT
D71	MIRROR O/S-LH & RH, REMOTE CONTROL, ELECTRIC, MANUAL FOLDING
D75	HANDLE O/S DOOR-BODY COLOR
D9O	SENSOR-FRONT AIRBAG (EFS) - SINGLE
DA7	ARM REST-FRT SEAT, LH
DBZ	HANDLE, REAR CLOSURE-O/S, DECKLID/ TAILGATE, SATIN CHROME
DLS	MIRROR O/S-LH & RH, REMOTE CONTROL, ELECTRIC, HEATED, MANUAL FOLDING, COLOR, TURN SIG IND
DLV	MIRROR I/S FRONT VAN – SUNSHADE, DRIVER AND PASSENGER, WITH MIRROR AND COVER
DQ9	MIRROR PROVISIONS – COLOR
DVW	CLUSTER COLOR-INST, PEARL BLUE
DVX	CLUSTER COLOR-INST, SWITCHBLADE SILVER MET
E17	BUMPER – 2.5 MPH
E22	HANDLE – ASSIST, REAR
E27	HANDLE – ASSIST, PASSENGER

RPO	Description
E5B	ACCESSORY-CHARGE CORD SET MODE2 CHARGING - GB/S 1363 TO TYPE 2 VEH CONN
E5E	ACCESSORY-CHARGE CORD SET MODE2 CHARGING - CEE 7/7 TO TYPE 2 VEH CONN W/ADAPTER
E91	POCKET – FRONT SEAT BACK, PASSENGER
EL7	COUNTRY-UNITED STATES OF AMERICA (USA)
EN0	ENGINE-NONE
ERI	EQUIPMENT – BATTERY SAVER
ESF	TRIM SEAT-PVC LEATHER, MOTION
EVL	PROP ENGY STOR PACK-PROPULSION BATTERY, LI, 360V, 60AH, UNDERBODY
EYA	TRIM SEAT-CLOTH, BLUE RAY
FCP	TRIM DOOR – POLYPROPYLENE
FE9	CERTIFICATION-EMISSION, FEDERAL
FJP	VEHICLE FUEL-(NONE)
FX3	RIDE AND HANDLING – AUTOMATIC ELECTRONIC CONTROLLED
FX6	RATIO-TRANSAXLE FINAL DRIVE 3.87
G54	PRIMARY COLOR-EXTERIOR, BLUE RAY (189X)
G6E	PRIMARY COLOR-EXTERIOR, SOLAR RED(338X)
G6F	PRIMARY COLOR-EXTERIOR, FRESH GREEN LIME(340X)
GAN	PRIMARY COLOR – EXTERIOR, SWITCHBLADE SILVER MET (G) 636R
GAR	PRIMARY COLOR – EXTERIOR, CARBON FLASH MET (G) 501Q
GAZ	PRIMARY COLOR – EXTERIOR, OLYMPIC WHITE (G) 8624
GZD	PRIMARY COLOR-EXTERIOR, MARANELLO RED (489P)
I15	ENGINEERING YEAR-2015
JBJ	BOOSTER-BRAKE - NONE
JL9	BRAKE SYSTEM-PWR, FRT & RR DISC, ANTILOCK, FRT & RR WHL
K06	FAN – ELECTRIC COOLING
K34	CRUISE CONTROL-AUTOMATIC, ELECTRONIC
K5W	BATTERY-LN1, AGM, 12V, 50AH, 520ENCCA
KRH	FILTER-AIR, POLLUTANT & ODOR
KTI	KIT, TIRE-INFLATOR
KWP	GENERATOR-NONE
LHD	VEHICLE DRIVE – LEFT HAND DRIVE
MAH	MARKETING AREA-US, PUERTO RICO/USVI
MAM	MARKETING AREA-MIDDLE EAST
MBC	MARKETING AREA-CANADA

RPO	Description
MBM	MARKETING AREA-EUROPE GROUP
MDC	MOLDING B/S UPPER-BRIGHT
MME	TRANSMISSION-AUTO, ELECTRIC, GM, GXE, GEN 1, DRIVE UNIT, X46F
N33	STEERING COLUMN – TILT TYPE
N45	STEERING WHEEL – 3 SPOKES
NC9	EMISSION SYSTEM-CALIFORNIA, ZEV
NE1	CERTIFICATION-EMISSION, GEOGRAPHICALLY RESTRICTED REGISTRATION FOR VEHICLES UP TO 14, 000 LBS GVW (USE 2003 MDL YR
NJ1	STEERING-POWER, NON-VARIABLE RATIO, ELECTRIC
NQB	CONTROL – STEERING WHEEL, LEATHER WRAPPED (GMDAT)
NT7	EMISSION SYSTEM-FEDERAL, TIER 2
RHD	VEHICLE DRIVE – RIGHT HAND DRIVE
RJV	TIRE ALL-185/55R15 SL 82T BW HW3 (FRONT) 195/55R15 SL 85T BW HW3 (REAR)
RJW	WHEEL-15 X 6.0, J, FRT & 15 X 6.5, J, RR, ALUMINUM, DESIGN 1
RWR	ACCESSORY-CAMERA - REAR VISION
SAC	ACCESSORY-CHARGE STATION - 220/240V HARDWIRED WALL MOUNTED W/ FIXED CABLE AND SAE VEH CONN
SAI	ACCESSORY-SILL PLATES - STAINLESS
SAO	ACCESSORY-SMOKERS PACKAGE
SBZ	ACCESSORY-SPORT PEDAL KIT
SDS	ACCESSORY-WEATHER DEFLECTORS - SIDE WINDOW - SMOKED
STO	REMOTE STOP-CHARGING
T2Y	PROVISIONS – SEAT, CHILD
T3X	LAMP SYSTEM – DAYTIME RUNNING, REGULAR INTENSITY LOW BEAM
T79	LAMP – FOG, REAR
T83	CONTROL, HEADLAMPS-AUTOMATIC ON-OFF
T89	LAMP – TAIL AND STOP, EXPORT
T94	HEADLAMPS CONTROL – LH RULE OF THE ROAD
TB8	HEADLAMPS CONTROL – RH RULE OF THE ROAD
TD1	REFLECTOR – SAFETY TRIANGLE
TDY	ORNAMENTATION – LETTERING, "CHEVROLET"
TFC	ALARM – SEAT BELT WARNING, PASSENGER
TH5	HEIGHT ADJUSTMENT – SAFETY BELT, FRONT SEAT
TR1	LAMP-TAIL & STOP
TR6	HEADLAMPS CONTROL – LEVELING SYSTEM, MANUAL
TT9	LAMP-STOP, HIGH LEVEL, LED TYPE

RPO	Description
TTQ	SPOILER – REAR, ROOF, SPORT, ENLARGED
U04	HORN – SINGLE NOTE
U05	HORN – DUAL
U18	SPEEDOMETER – INSTRUMENT, KILOMETER
U25	LAMP – INTERIOR, REAR COMPARTMENT, COURTESY
U2K	DIGITAL AUDIO SYSTEM-S-BAND
U2Q	DIGITAL AUDIO SYSTEM-INTEGRATED TYPE DAB/DAB+/DMB-R
U71	ANTENNA – ROOF, RADIO
UBA	ANTENNA-ROOF, RADIO, GPS, PHONE, S BAND XM
UBG	ANTENNA-ROOF, RADIO, PHONE, DIGITAL AUDIO SYSTEM, (DAS)
UC1	SPEEDOMETER – INSTRUMENT, MILES
UC3	CONTROL-STEERING WHEEL, RADIO & PHONE, REDUNDANT CONTROLS
UD7	SENSOR INDICATOR – REAR PARKING ASSIST
UDV	DISPLAY INSTRUMENT-DRIVER INFO ENHANCED, FULL CLUSTER (MULTI COLOR GRAPHIC)
UDZ	DISPLAY – TRIP COMPUTER
UE1	COMMUNICATION SYSTEM-VEHICLE, ONSTAR
UF7	RADIO-AM/FM STEREO, SEEK/SCAN, ETR, CLOCK DSP, MP3/WMA, USB, AUX/ IN, WIRELESS INTERFACE
UFA	DISPLAY-OUTSIDE TEMPERATURE
UH0	INDICATOR – SEAT BELT WARNING , LH
UH1	INDICATOR – SEAT BELT WARNING , RH
UJM	TIRE PRESS INDICATOR-MANUAL LEARN
USR	RECEPTACLE-USB
UTJ	THEFT DETERRENT – ELECTRICAL, UNAUTHORIZED ENTRY
UVC	VISION-REAR VIEW
UW6	SPEAKER SYSTEM – 6, CUSTOM
VEE	BUMPER FRONT – BODY COLOR, FRONT AND REAR
VGC	PROTECTOR-FILM, PAINT ETCH PREVENTIVE
VHY	PROTECTOR – BODY SHEET METAL, HIGH CORROSION PREVENTIVE
VIX	PLATE – VEHICLE IDENTIFICATION – VISUAL (GMDAT)
VIY	PLATE – VEHICLE IDENTIFICATION – ASTERISK (*) MARK (GMDAT)
VK3	LICENSE PLATE FRONT-FRT MOUNTING PKG
VL4	LICENSE PLATE FRONT – FRONT MOUNTING PACKAGE, EEC
VMA	LICENSE PLATE FRONT – FRONT MOUNTING PACKAGE, KOREA
VNU	VIN FORMAT – U.S. TYPE
VNV	VIN FORMAT – KOREA TYPE
VNW	VIN FORMAT – EU (ISO) TYPE
VV4	COMMUNICATION EQUIP-MOBILE INTERNET CONNECTIVITY
W2V	ORNAMENTATION-LETTERING, VAR - NONE
WGK	ACCESSORY-INTERIOR TRIM KIT - DESIGN 1
WGL	ACCESSORY-INTERIOR TRIM KIT - DESIGN 2
WGM	ACCESSORY-INTERIOR TRIM KIT - DESIGN 3
WGT	ACCESSORY-INTERIOR TRIM KIT - DESIGN 4
WHB	EQUIPMENT-ENHANCED ELECTRONIC MODULE SIGNAL SPEED, GM-LAN
WJD	ORNAMENTATION-NAME PLATE "SPARK EV"
WMF	VIN MODEL YEAR-2015
WU5	SWITCH – I/P LP DIMMER
Y9Y	ORNAMENTATION – DECAL "CHEVROLET"
YF5	CERTIFICATION-EMISSION, CALIFORNIA
Z49	COUNTRY-CANADA
ZPN	WARRANTY-36,000 MILE, 3 YEARS
ZY0	WARRANTY-50,000 KM, 2 YEARS
ZY9	WARRANTY-100,000 KM, 3 YEARS

Fasteners

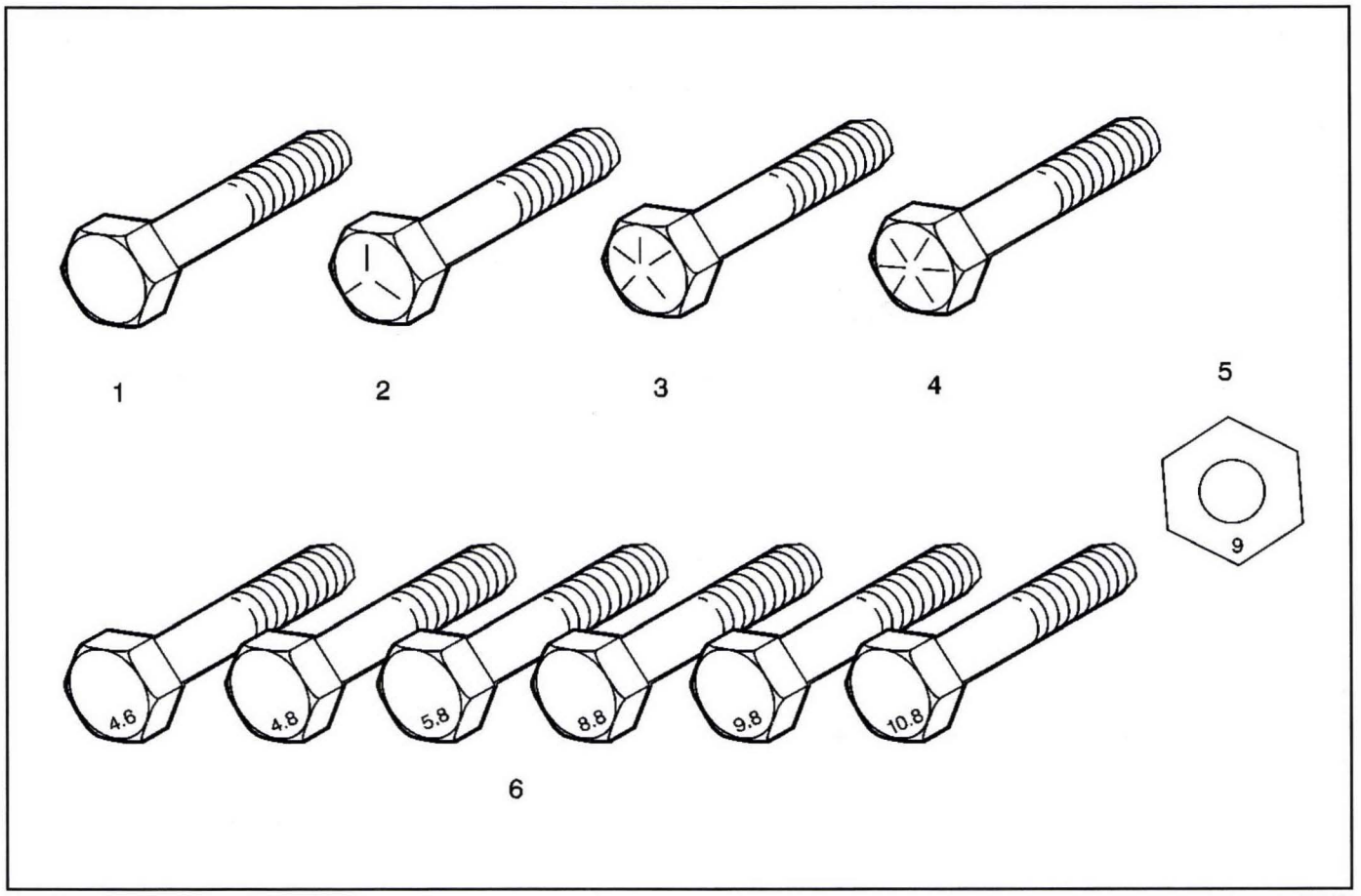
Metric Fasteners

This vehicle provides fastener dimensions using the metric system. Most metric fasteners are approximate in diameter to equivalent English fasteners. Make replacements using fasteners of the same nominal diameter, thread pitch, and strength.

A number marking identifies the OE metric fasteners except cross-recess head screws. The number also indicates the strength of the fastener material. A Posidrive® or Type 1A cross-recess identifies a metric cross-recess screw. For best results, use a Type 1A cross-recess screwdriver, or equivalent, in Posidrive® recess head screws.

GM Engineering Standards and North American Industries have adopted a portion of the ISO-defined standard metric fastener sizes. The purpose was to reduce the number of fastener sizes used while retaining the best thread qualities in each thread size. For example, the metric M6.0 X 1 screw, with nearly the same diameter and 25.4 threads per inch replaced the English 1/4–20 and 1/4–28 screws. The thread pitch is midway between the English coarse and fine thread pitches.

Fastener Strength Identification



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Legend

(1) English Bolt, Grade 2 (Strength Class)
(2) English Bolt, Grade 5 (Strength Class)
(3) English Bolt, Grade 7 (Strength Class)
(4) English Bolt, Grade 8 (Strength Class)
(5) Metric Nut, Strength Class 9
(6) Metric Bolts, Strength Class Increases as Numbers Increase

The most commonly used metric fastener strength property classes are 9.8 and 10.9. The class identification is embossed on the head of each bolt. The English, inch strength classes range from grade 2 to grade 8. Radial lines are embossed on the head of each bolt in order to identify the strength class. The number of lines on the head of the bolt is 2 lines less than the actual grade. For example, a grade 8 bolt will have 6 radial lines on the bolt head. Some metric nuts are marked with a single digit strength identification number on the nut face.

The correct fasteners are available through GM SPO. Many metric fasteners available in the aftermarket parts channels are designed to metric standards of countries other than the United States, and may exhibit the following:

- Lower strength
- No numbered head marking system
- Wrong thread pitch

The metric fasteners on GM products are designed to new, international standards. The following are the common sizes and pitches, except for special applications:

- M6.0 X 1
- M8 X 1.25
- M10 X 1.5
- M12 X 1.75
- M14 X 2.00
- M16 X 2.00

Prevailing Torque Fasteners

Prevailing torque fasteners create a thread interface between the fastener and the fastener counterpart in order to prevent the fastener from loosening.

All Metal Prevailing Torque Fasteners

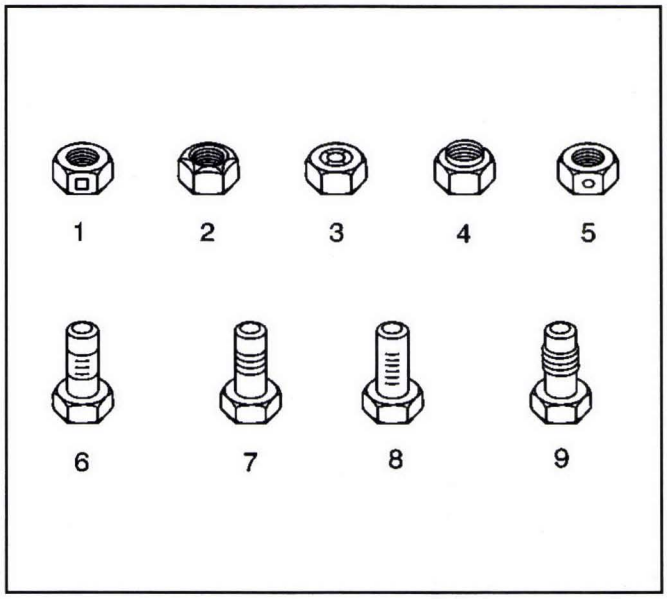
These fasteners accomplish the thread interface by a designed distortion or deformation in the fastener.

Nylon Interface Prevailing Torque Fasteners

These fasteners accomplish the thread interface by the presence of a nylon material on the fastener threads.

Adhesive Coated Fasteners

These fasteners accomplish the thread interface by the presence of a thread-locking compound on the fastener threads. Refer to the appropriate repair procedure in order to determine if the fastener may be reused and the applicable thread-locking compound to apply to the fastener.



171892

Legend

(1) Prevailing Torque Nut, Center Lock Type
(2) Prevailing Torque Nut, Top Lock Type
(3) Prevailing Torque Nut, Nylon Patch Type
(4) Prevailing Torque Nut, Nylon Washer Insert Type
(5) Prevailing Torque Nut, Nylon Insert Type
(6) Prevailing Torque Bolt, Dry Adhesive Coating Type
(7) Prevailing Torque Bolt, Thread Profile Deformed Type
(8) Prevailing Torque Bolt, Nylon Strip Type
(9) Prevailing Torque Bolt, Out-of-Round Thread Area Type

A prevailing torque fastener may be reused ONLY if:

- The fastener and the fastener counterpart are clean and not damaged
- There is no rust on the fastener
- The fastener develops the specified minimum torque against its counterpart prior to the fastener seating

Metric Prevailing Torque Fastener Minimum Torque Development

Application	Specification	
	Metric	English
All Metal Prevailing Torque Fasteners		
6 mm	0.4 N•m	4 lb in
8 mm	0.8 N•m	7 lb in
10 mm	1.4 N•m	12 lb in
12 mm	2.1 N•m	19 lb in

Metric Prevailing Torque Fastener Minimum Torque Development (cont'd)

Application	Specification	
	Metric	English
14 mm	3 N•m	27 lb in
16 mm	4.2 N•m	37 lb in
20 mm	7 N•m	62 lb in
24 mm	10.5 N•m	93 lb in
Nylon Interface Prevailing Torque Fasteners		
6 mm	0.3 N•m	3 lb in
8 mm	0.6 N•m	5 lb in
10 mm	1.1 N•m	10 lb in
12 mm	1.5 N•m	13 lb in
14 mm	2.3 N•m	20 lb in
16 mm	3.4 N•m	30 lb in
20 mm	5.5 N•m	49 lb in
24 mm	8.5 N•m	75 lb in

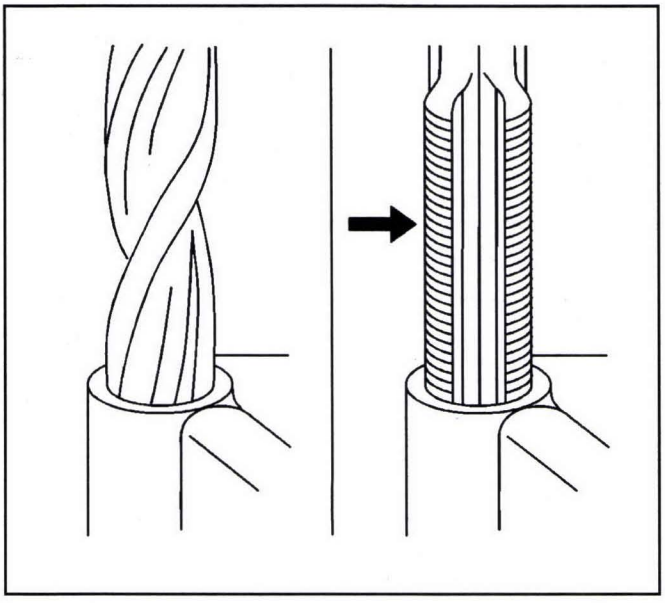
English Prevailing Torque Fastener Minimum Torque Development

Application	Specification	
	Metric	English
All Metal Prevailing Torque Fasteners		
1/4 in	0.5 N•m	4.5 lb in
5/16 in	0.8 N•m	7.5 lb in
3/8 in	1.3 N•m	11.5 lb in
7/16 in	1.8 N•m	16 lb in
1/2 in	2.3 N•m	20 lb in
9/16 in	3.2 N•m	28 lb in
5/8 in	4 N•m	36 lb in
3/4 in	7 N•m	62 lb in
Nylon Interface Prevailing Torque Fasteners		
1/4 in	0.3 N•m	3 lb in
5/16 in	0.6 N•m	5 lb in
3/8 in	1 N•m	9 lb in
7/16 in	1.3 N•m	12 lb in
1/2 in	1.8 N•m	16 lb in
9/16 in	2.5 N•m	22 lb in
5/8 in	3.4 N•m	30 lb in
3/4 in	5 N•m	45 lb in

Thread Inserts

General Purpose Thread Repair Kits.
These kits are available commercially.

Repair Procedure



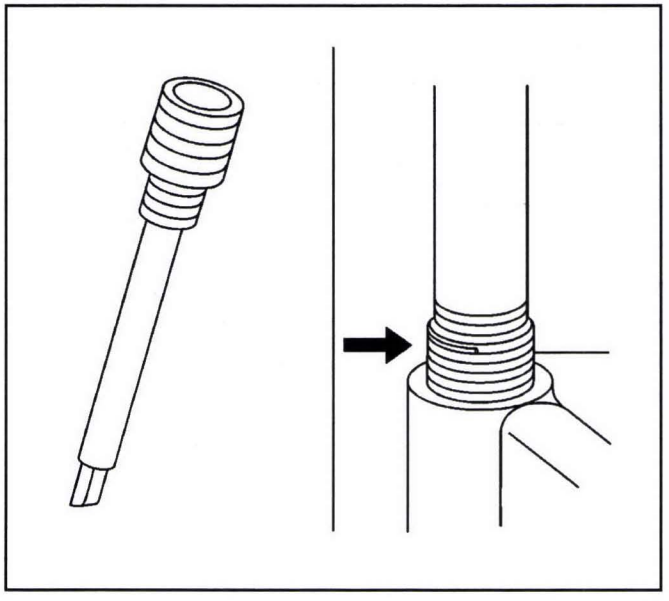
4962

Warning: Refer to Safety Glasses Warning on page 0-5.

Note: Refer to the thread repair kit manufacturer instructions regarding the size of the drill and tap to use.

Avoid any buildup of chips. Back out the tap every few turns and remove the chips.

1. Determine the size, the pitch, and the depth of the damaged thread. If necessary, adjust the stop collars on the cutting tool and tap to the required depth.
2. Drill out the damaged threads. Clean out any chips.
3. Lubricate the tap with light engine oil. Tap the hole. Clean the threads.



4963

4. Thread the thread insert onto the mandrel of the installer. Engage the tang of the insert onto the end of the mandrel.

   Note: The insert should be flush to one turn below the surface.
5. Lubricate the insert with light engine oil, except when installing in aluminum and install the insert.
6. If the tang of the insert does not break off when backing out the installer, break the tang off with a drift.

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Listed below are Registered Trademarks (®) or Non-Registered Trademarks (™) which may appear in this service manual.

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Door Lock and Ignition Lock Folding and Non-Folding Key Cutting

High Security keys are available from the service parts system.

Obtain the key code from the security card or from the GM Dealer World, Parts, Key Code Look Up system.

If you have the key code and access to a Triax-E., BD Laser or other code key cutting machine from the GM Dealer Equipment Catalog, you may cut a new key.

If you have the original key and access to a Matrix S, BD Laser or other key duplicating machine, you may duplicate the key.

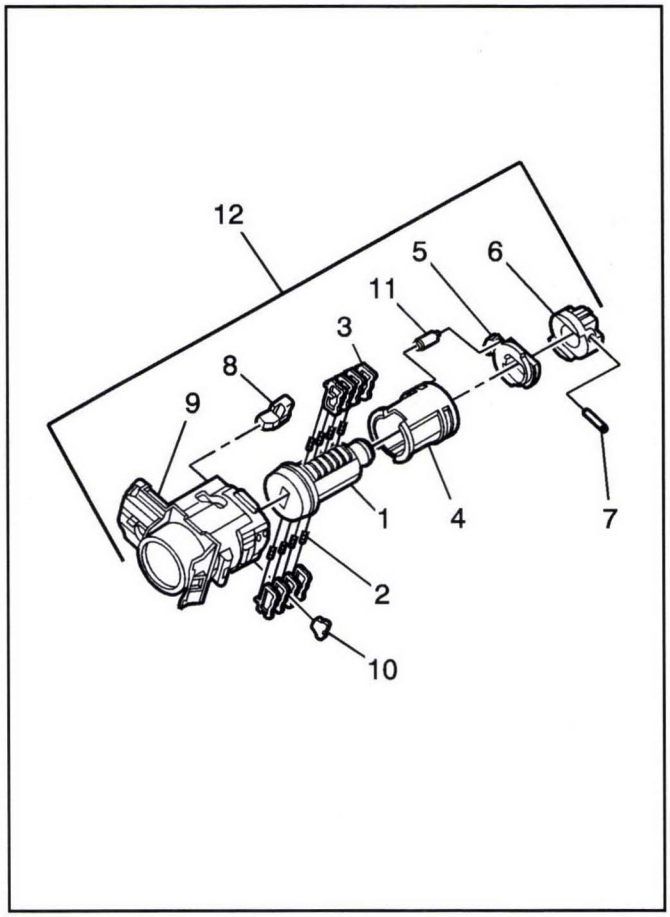
If you do not have a high security key cutting machine, order the side cut key from the service parts system. Include the key code in the NOTE field. Indicate the timing and the method of the shipment.

Inspect the new key operation in the lock cylinder. Ensure the new key operates effectively.

Front Side Door Lock Cylinder Coding (Free Wheeling)

Special Tools

BO-49753 Assembly Tool



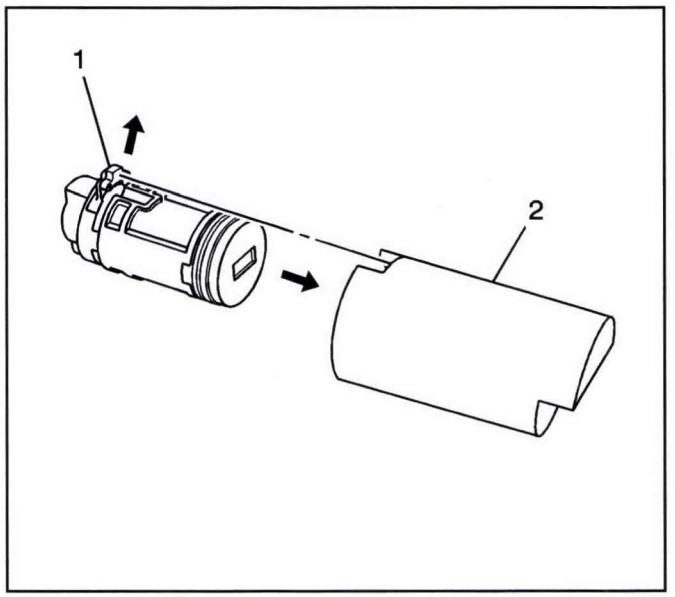
2196837

The door lock cylinder uses 8 of the 8 cut positions. The tumbler positions are staggered from side to side, 4 on one side and 4 on the other, are not self-retaining, and are not snap in.

Note: All lock cylinders for side milled keys have right and left tumblers. The location of the tooth of the tumbler determines whether it is right of left. Illustrations in this procedure show the right tumblers on the top and the left tumblers on the bottom. All tumblers are marked 1R, 1L, 2R, or 2L. The number being cut depth and the letter meaning right or left.

1. Hold the door lock cylinder (1) so the side with the 4 tumbler spring pockets faces up, pocket nearest to the cylinder head.
2. Insert the tumbler springs (2) into the 4 spring pockets. This side uses left tumblers.
3. Install the tumbler (3) for key cut position one in the slot nearest to the front of the lock cylinder. Install the remaining tumblers, key cut positions 3, 5, and 7, following the key code and same process. Press the tumblers in place until they are secure.
4. Check the correct loading of the tumblers by inserting the key into the cylinder. All tumblers should be flush with the lock cylinder body.
5. Turn the cylinder so the side with the 4 tumbler spring wells faces up. This side uses right tumblers.
6. Insert the tumbler springs into the 4 spring pockets.

7. The first tumbler closest to the front of the lock cylinder to be loaded will be the second key cut position, the second number in the key code. Install the remaining tumblers for the key cut positions 4, 6, and 8. Press the tumblers in place until they are secure.
8. Check the correct loading of the tumblers by inserting the key into the cylinder. All tumblers should be flush with the lock cylinder body.
9. Insert the key and lightly lubricate the cylinder body diameter and tumbler surfaces and a small amount in the head of the cylinder using the supplied grease.
10. Insert the sleeve (4) onto the cylinder assembly.
11. Insert the clutch (5) and driver (6) onto the cylinder (1).



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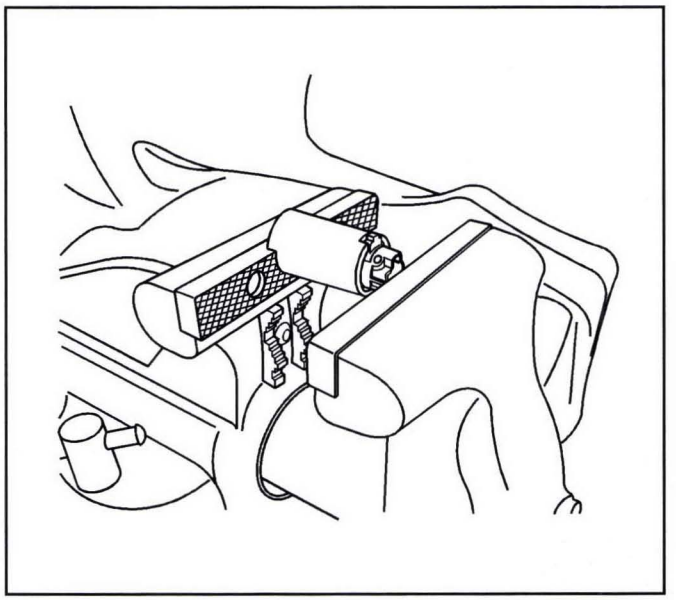
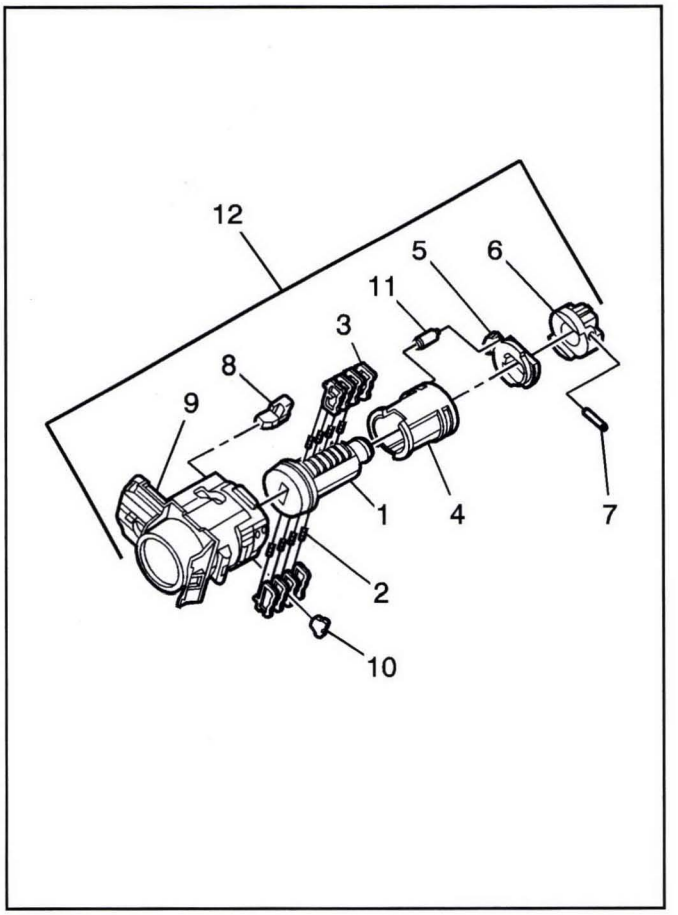
12. Load the cylinder into the *BO-49753* assembly tool so that the clutch (1) indexes with the notch in the opening of the tool (2).



2197416

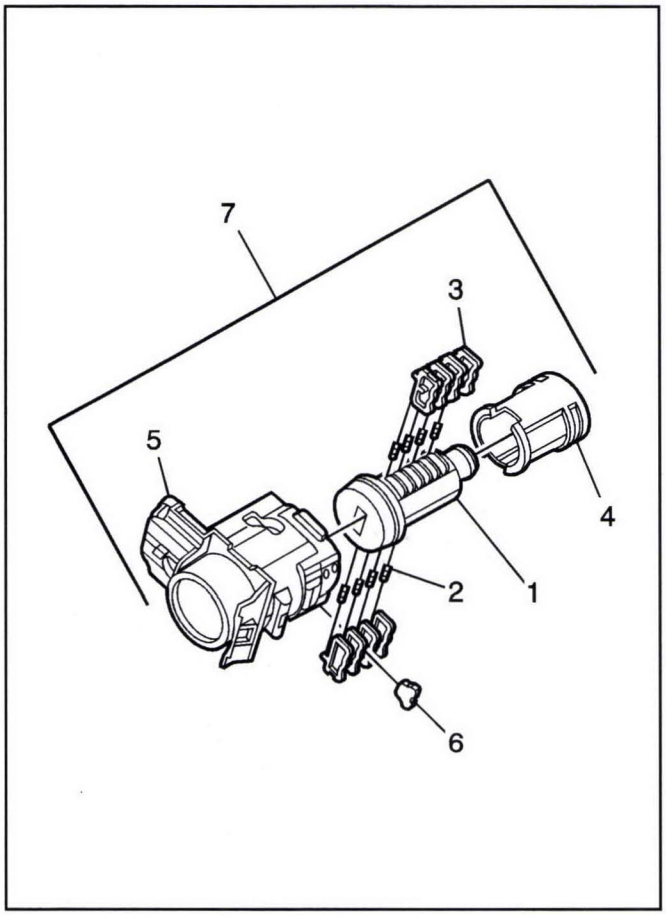
13. Load the assembly tool with the lock cylinder into a vice and tighten the vice ONLY enough to hold the tool and lock the cylinder in place.



2196837

14. Insert the roll pin (7) into the driver (6) and install it using a 1/16 inch pin punch.
15. Insert the buffer (8) in the case (9), verify the buffer is properly seated.
16. Install the free wheel pin (11) in the sleeve (4) and clutch (5) and insert the assembly into the case (9).
17. With the lock cylinder assembly installed in the case (9), install the retainer (10) and stake the retainer in place using a small punch and hammer to peen the case material onto the exposed ends of the installed retainer (10).
18. Insert the key into the lock and function the lock to check for proper assembly and smooth operation.

Front Side Door Lock Cylinder Coding (Non Free Wheeling)



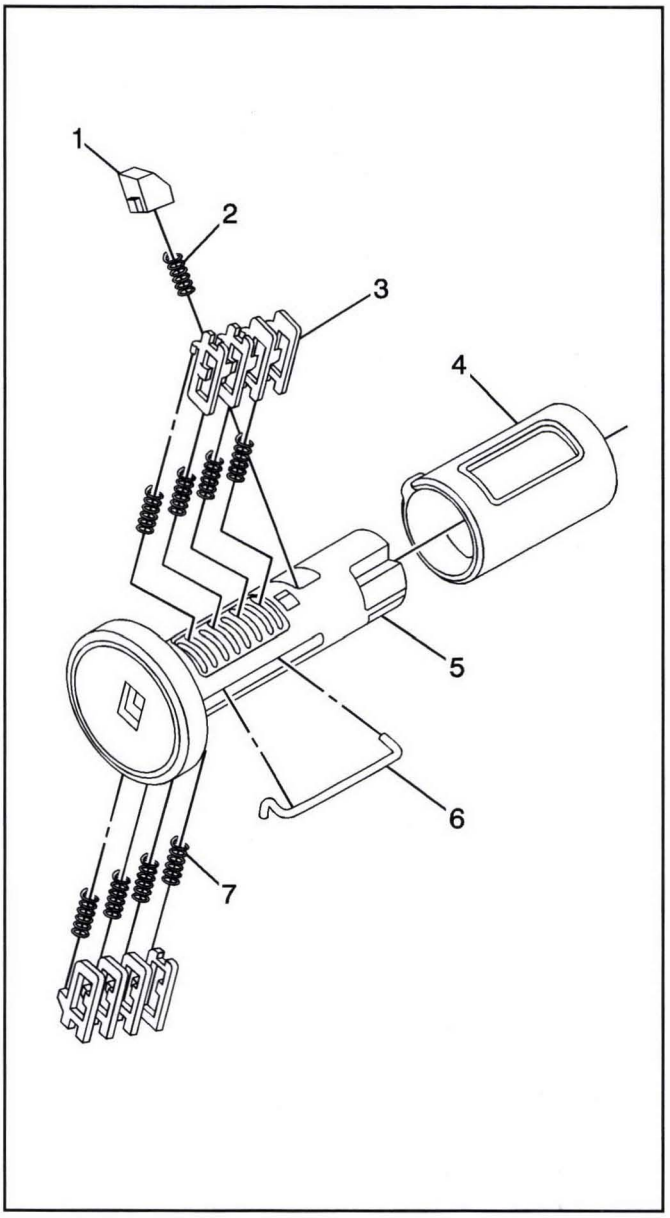
2225941

The door lock cylinder uses 8 of the 8 cut positions. The tumbler positions are staggered from side to side, 4 on one side and 4 on the other, are not self-retaining, and are not snap in.

Note: All lock cylinders for side milled keys have right and left tumblers. The location of the tooth of the tumbler determines whether it is right of left. Illustrations in this procedure show the right tumblers on the top and the left tumblers on the bottom. All tumblers are marked 1R, 1L, 2R, or 2L. The number being cut depth and the letter meaning right or left.

1. Hold the door lock cylinder (1) so the side with the 4 tumbler spring pockets faces up, pocket nearest to the cylinder head.
2. Insert the tumbler springs (2) into the 4 spring pockets. This side uses left tumblers.
3. Install the tumbler (3) for key cut position one in the slot nearest to the front of the lock cylinder. Install the remaining tumblers, key cut positions 3, 5, and 7, following the key code and same process. Press the tumblers in place until they are secure.
4. Check the correct loading of the tumblers by inserting the key into the cylinder. All tumblers should be flush with the lock cylinder body.
5. Turn the cylinder so the side with the 4 tumbler spring wells faces up. This side uses right tumblers.
6. Insert the tumbler springs into the 4 spring pockets.
7. The first tumbler closest to the front of the lock cylinder to be loaded will be the second key cut position, the second number in the key code. Install the remaining tumblers for the key cut positions 4, 6, and 8. Press the tumblers in place until they are secure.
8. Check the correct loading of the tumblers by inserting the key into the cylinder. All tumblers should be flush with the lock cylinder body.
9. Insert the key and lightly lubricate the cylinder body diameter and tumbler surfaces and a small amount in the head of the cylinder using the supplied grease.
10. Insert the sleeve (4) onto the cylinder assembly.
11. Insert the assembly into the case (5).
12. With the lock cylinder assembly installed in the case (5), install the retainer (6) and stake the retainer in place using a small punch and hammer to peen the case material onto the exposed ends of the installed retainer (6).
13. Insert the key into the lock and function the lock to check for proper assembly and smooth operation.

Lock Cylinder Coding - Ignition



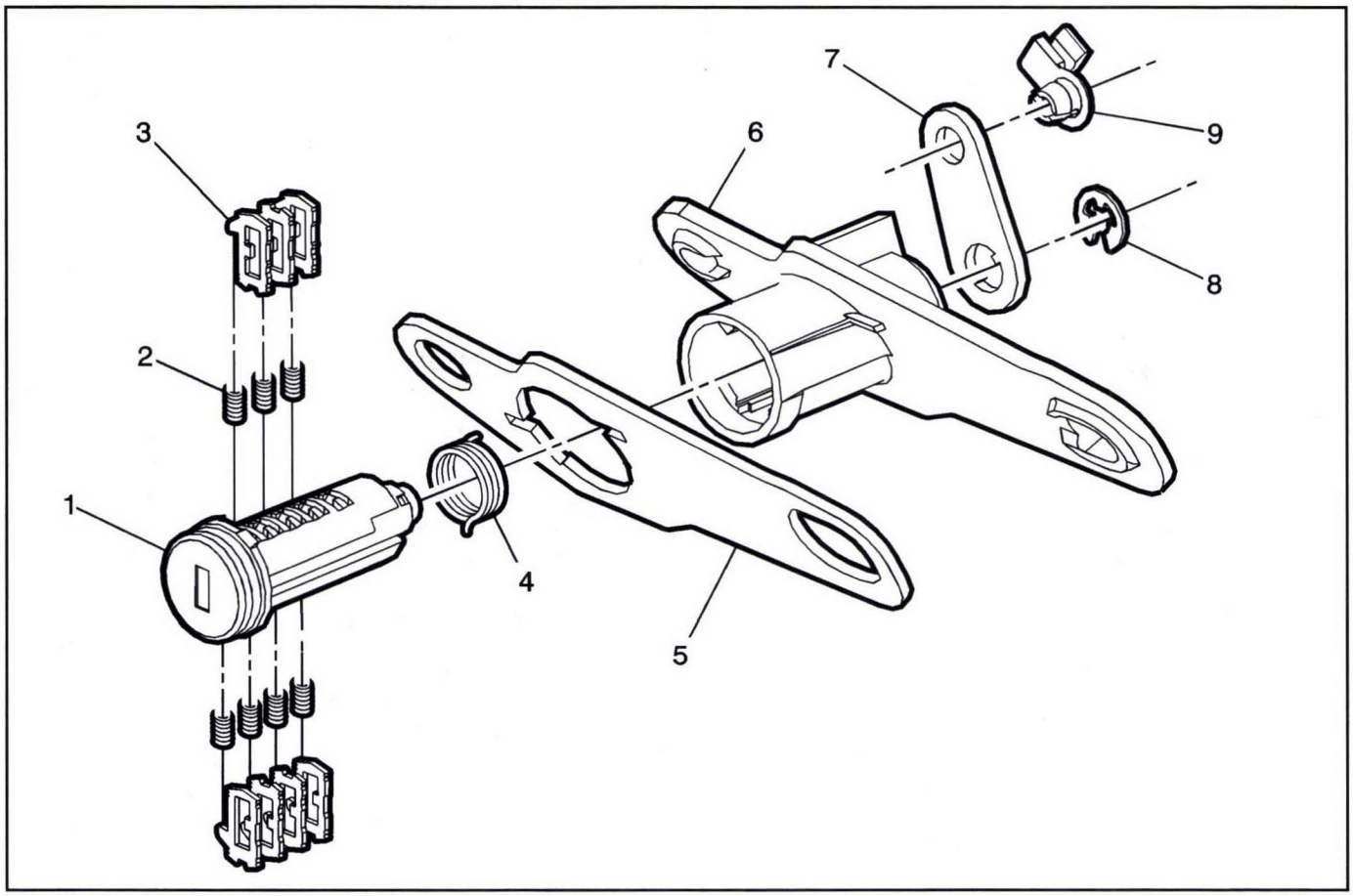
2197408

The ignition lock cylinder uses 8 key cut positions, 1–8. The ignition cylinder tumblers (3) are located on alternate sides of the cylinder (5). They are not snap-in and are not self-retaining. It follows the key code with the first tumbler being the first depth of the key code, closest to the head of the key.

Note: All lock cylinders for side milled keys have right and left tumblers. The location of the tooth of the tumbler determines whether it is right of left. Illustrations in this procedure show the right tumblers on the top and the left tumblers on the bottom. All tumblers are marked 1R, 1L, 2R, or 2L. The number being cut depth and the letter meaning right or left.

1. Hold the ignition cylinder assembly (5) so the side with the tumbler spring pocket located closest to the head of the cylinder is facing up.
2. Insert the tumbler spring (7) into each of the 4 spring pockets of the cylinder assembly. This side of the cylinder used left tumblers.
3. The first tumbler (3) to be loaded will be the first key cut position, which is the first number in the key code. Install the tumbler in the slot over the spring. Install the remaining right tumblers following the key code and same process, pressing the tumblers in place until they are secure.
4. Rotate the cylinder assembly. Insert the tumbler spring into each of the spring pockets of the cylinder assembly. This side of the cylinder used right tumblers.
5. The first tumbler (3) to be loaded will be the second key cut position, the second number in the key code. Install the first tumbler in the slot over the spring. Install the remaining left tumblers following the key code and same process, pressing the tumblers in place until they are secure.
6. Inspect for correct loading of the tumblers by inserting the key into the cylinder. All tumblers should drop flush with the lock cylinder body diameter.
7. With the key in the cylinder assembly insert the round connector (6), insert the retainer spring (2) in the retainer slot located in the cylinder assembly. Insert the retainer (1) lining it up in the slot over the spring. Depress the retainer and hold.
8. Insert the cylinder into the sleeve (4) as shown in the print. Make sure the actuator stays located properly in the cylinder.
9. When the key is removed, the lock should stay together.
10. Lightly lubricate the outside surface in the tumbler area of in the lock body and down the key slot using the provided grease. Insert and extract the key 5 times to lubricate the keyway.
11. Insert the key and function the lock 3 times to distribute the grease inside the sleeve.
12. Verify the key position for inserting the lock into the column.

Rear Compartment Lid Lock Cylinder Coding



2510231

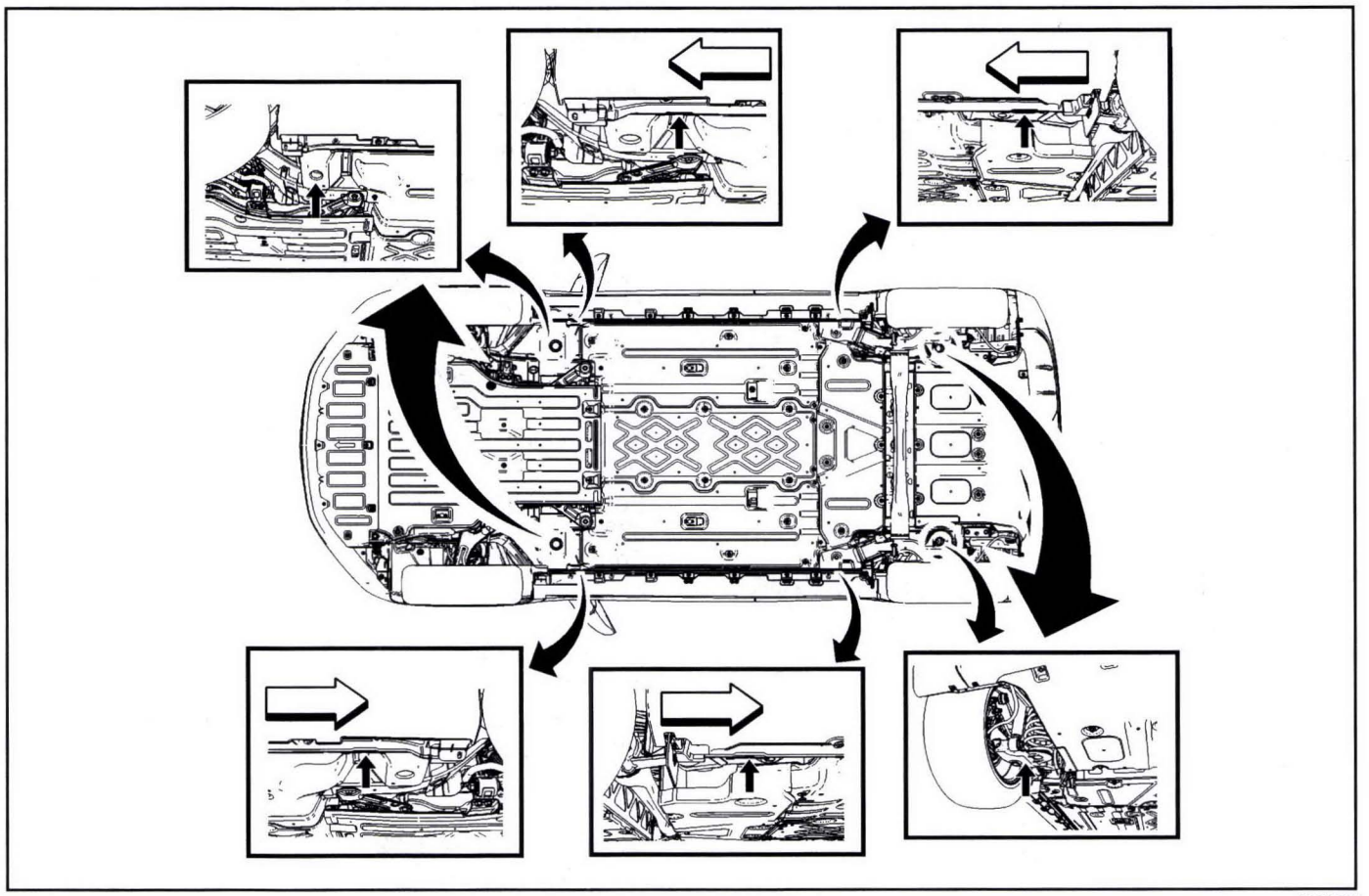
The rear compartment lid lock cylinder uses 7 of the 7 cut positions. The tumbler positions are staggered from side to side, 4 on one side and 3 on the other, are not self-retaining, and are not snap in.

Note: All lock cylinders for side milled keys have right and left tumblers. The location of the tooth of the tumbler determines whether it is right or left. Illustrations in this procedure show the right tumblers on the top and the left tumblers on the bottom. All tumblers are marked 1R, 1L, 2R, or 2L. The number being cut depth and the letter meaning right or left.

1. Tumbler spring (2) and tumbler (3) are to be assembled into the cylinder (1). In this case start with the tumbler nearest the cylinder head and work through until the last tumbler at the base. Use the key as a tool by pushing it in step by step to hold the already assembled tumblers in place.
2. Check the correct loading of the tumblers by inserting the key into the cylinder. All tumblers should be flush with the lock cylinder body.
3. Assemble the restoring spring (4) onto the rear of the cylinder.
4. Tape the pad (5) onto the housing (6).
5. Grease the housing.
6. Insert the lock cylinder (1) into the housing (6). Remove the key from the cylinder.
7. Install the lever (7) onto the end of the cylinder (1).
8. Attach the E-ring (8) to the cylinder, then crimp it to retain the lever assembly.
9. Snap the rod retainer (9) into the hole in the lever (7).
10. Insert the key into the lock and function the lock to check for proper assembly and smooth operation.

Lifting and Jacking the Vehicle

Note: The use of a LOW PROFILE LIFT ARMS SYSTEM may be required to avoid unwanted contact with the vehicle body and structure depending on lifting equipment used. Refer to the manufacturer recommendation for their applications of low profile lift arms system for their lifting equipment.



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Danger: To avoid any vehicle damage, serious personal injury or death when major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.

Danger: To avoid any vehicle damage, serious personal injury or death, always use the jackstands to support the vehicle when lifting the vehicle with a jack.

Caution: Perform the following steps before beginning any vehicle lifting or jacking procedure:

- Remove or secure all of the vehicle contents in order to avoid any shifting or any movement that may occur during the vehicle lifting or jacking procedure.
- The lifting equipment or the jacking equipment weight rating must meet or exceed the weight of the vehicle and any vehicle contents.
- The lifting equipment or the jacking equipment must meet the operational standards of the lifting equipment or jacking equipment manufacturer.
- Perform the vehicle lifting or jacking procedure on a clean, hard, dry, level surface.
- Perform the vehicle lifting or jacking procedure only at the identified lift points. DO NOT allow the lifting equipment or jacking equipment to contact any other vehicle components.

Failure to perform the previous steps could result in damage to the lifting equipment or the jacking equipment, the vehicle, and/or the vehicle contents.

Vehicle Lifting– Frame Contact Lift

Front Lift Pads

When lifting the vehicle with a frame-contact lift, place the front lift pads on the rocker outer panel weld flange, as shown.

Rear Lift Pads

When lifting the vehicle with a frame-contact lift, place the rear lift pads on the rocker outer panel weld flange, as shown.

Vehicle Jacking

Caution: When you are jacking the vehicle at the front locations, be certain that the jack or the jack lift pad does not contact the front fascia, front fascia air dam, or the front fenders. If such contact occurs, vehicle damage may result. When jacking at selected front locations additional clearance may be required for the jacking points.

Note: When you are lifting a vehicle with a service jack, block the wheels at the opposite end from which you are lifting. Use jack stands to provide additional support.

When using a service jack under the front of the vehicle use one of the following locations:

Front of Vehicle

Place the service jack pad at the outrigger, as shown with rubber or wood block.

Rear of Vehicle

Note: Place jackstands ONLY under strong and stable vehicle structures.

Place the service jack pad at the rear spring seat, as shown with rubber or wood block.

Special Tools and Equipment

Special Tools Ordering Information

Special Tools

The special service tools shown in this service manual that have product numbers beginning with J, BO, GE, CH, DT, EN, EL, SA, OR KM are available for worldwide distribution.

US, Canada and Caribbean only:

Note: For Special Service tools only - see different location below for diagnostic tools & equipment.

Bosch Automotive Service Solutions
28635 Mound Road
Warren, MI, 48092-3499U.S.A

Phone: 1-800-GM-TOOLS
Monday through Friday
8:00 am–7:00 pm Eastern Standard Time
Fax: 1-800-578-7375 or 586-578-7321
gmspecialservicetools.service-solutions.com

Mexico, Including Central America:

Bosch Automotive Service Solutions
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03600 Mexico CityMexico

Phone: +5255 2595 1630
Fax: +5255 2595 1639
Inquiries can be sent to:
herramientas@service-solutions.com

South America, Excluding Brazil:

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Mitla No.442 Col. Vertiz Narvarte
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Fax: +5255 2595 1639
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Phone: 82-31-457-9520
sales.korea@servicesolutions.com
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Greater China, SGM,SGMW,FAW-GM, GM OPEL China:

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Australia:

Bosch Automotive Service Solutions Australia
300 Wellington Road,
Mulgrave
Vic. 3170

Phone: 61 3 9544 6222
Fax: 61 3 9544 5222
Inquiries can be sent to:
customerservice.au@service-solutions.com

Iberica S.A.

Dealers based in Spain, Portugal and Canary Islands:

Bosch Automotive Service Solutions Europe
Nave 72 (Nudo Oeste), 19004 Guadalajara,Spain

Phone: 34 949 208 337
Fax: 34 949 208 327
shop.service-solutions.com

Europe GmbH

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Italy

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Via provinciale, 12, 43038 Sala Baganza-PR,Italy

Phone: 39 -521 837 508
Fax: 39 - 521 335 385
shop.service-solutions.com

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Warren, MI, U.S.A, 48092-3463

Phone: 1-800-GM-TOOLS
Monday through Friday
8:00 am–6:00 pm EST
Fax: 1-586-578-7205
www.GMDEsolutions.net (US only) or
www.des-canada.ca (Canada only)

Air/Wind Noise

Diagnostic Information and Procedures

Air/Wind Noise

Special Tools

- *CH-39570* Chassis Ear
- *GE-41416* Ultrasonic Leak Detector

Warning: Refer to Assistant Driving Warning on page 0-3.

To analyze a reported windnoise condition, test drive the vehicle to determine the origin of the noise.

Choose a regular route with smooth and straight streets that run in all 4 directions: North, South, East, and West. The area should have little traffic or little noise in order to eliminate interference with the test.

Note: Often there is one primary leak source and one or more secondary leaks that contribute to the noise condition. Repairing only one of the contributing leak sources may not completely repair the total condition but only reduce the condition.

Drive the vehicle at the speed in which the noise was noticed, or until the noise is heard. Maintain safe and legal speeds.

Many of the waterleak diagnosis tests are also used for the windnoise diagnosis.

Most windnoise is caused either by leaking seals or by misaligned body surfaces. You can diagnose the following types of windnoise with the aid of *CH-39570* chassis ear or *GE-41416* leak detector.

- Wind whistle
- Wind roar
- Wind rush

When moving at highway speeds, air pressure inside the vehicle becomes greater than the air pressure outside. When a leak occurs, the escaping air causes a hiss or a whistle.

Wind roar occurs when air passes over or through an opening between the 2 body surfaces. To correct the condition, adjust the alignment to the body surfaces.

Wind rush occurs when air presses over the vehicles body and is related to the aerodynamics of the vehicle. Wind whistle and wind roar are repairable. Rule out wind whistle and wind roar before concluding that the wind noise is due to wind rush.

Use the following inspections in order to aid in diagnosing wind whistle or wind roar:

1. Note the details for wind noise:
   - The perceived location
   - The location where the noise is loudest
   - When the noise occurs
   - The vehicle speed
   - The interior fan speed
   - The position of the windows
   - What the noise sounds like
2. Inspect the vehicle for the possible cause of the windnoise.
3. Test drive the vehicle and determine if the windnoise is external or internal.
4. Perform a visual inspection of the following components:
   - Loose fasteners
   - Torn weatherstrips
   - Broken weld joints
   - Sealer and/or adhesive skips

Tracing Powder or Chalk Test

Clean the weatherstrips and the contact surfaces with cleaning solvent.

1. Apply powder or chalk in an unbroken line to the contact surface of the weatherstrip surrounding the perimeter of the suspected areas.
2. Close the panel completely without slamming the panel. Closing the panel completely presses the weatherstrip firmly against the mating surface.
3. Inspect the applied line on the weatherstrip. The applied line is marred where contact is good. A corresponding imprint is on the mating surfaces.
4. Gaps or irregularities in the powder or the chalk line on the mating surfaces indicate the areas with a poor seal.

Air Pressure Test

1. Mask off both the pressure relief valves.
2. Close all the windows.
3. Turn the vehicles ventilation fan to the on position, with the selector on high speed and in the defrost mode.
4. Unlock and close the doors.
5. Listen for escaping air along the door and the window seals with a stethoscope or a length of heater hose.

Soap Suds or Bubble Test

1. Mask off the pressure relief valves.
2. Close all the windows and the doors.
3. Turn the vehicles ventilation fan to the on position, with the selector on high speed and in the defrost mode.
4. Unlock and close the doors.
5. Apply the soap solution to the potential leak areas.
6. Look for bubbles revealing escaping air.

Repair Instructions

Exterior Windnoise

Warning: Refer to Assistant Driving Warning on page 0-3.

Exterior windnoise is louder when the vehicle is driven with one or more windows down. Exterior windnoise occurs when air passes over the body panels, the seams, or the openings. Use the following items during the test drive in order to aid in the detection of leaks:

- Mechanic's stethoscope or heater hose
- Masking tape–51 mm (2 in) width
- Strip caulk
- A water soluble marking pencil

1. While driving, determine the location of the exterior windnoise by lowering one window at a time. If the location corresponds with the condition in step 2, pull over and make a temporary repair with 51 mm (2 in) wide masking tape.
2. Tape over the gaps and the moldings one at a time. Test between each taping. Taping over the gaps and moldings will correct the condition.
3. Temporarily repair the condition with masking tape. Adjust the tape when needed.
4. Continue testing in order to determine if the noise has been eliminated or other leak areas exist.
5. When all the reported leak conditions are located, make permanent repairs using the proper alignment techniques and the sealing materials.

Interior Windnoise

Warning: Refer to Assistant Driving Warning on page 0-3.

Interior windnoise is not heard when the window is lowered. Interior windnoise is caused by the air leaving the inside of the vehicle through a seal or a seam.

1. Tape over the relief valves to cause added air pressure within the vehicle.
2. Test drive the vehicle and listen for windnoise or a whistle.
3. Pull the vehicle over and make the temporary repairs using masking tape. If you cannot determine the source of the windnoise, perform one or more of the following diagnostic tests:
   - *Air Pressure Test on page 1-30*
   - *Soap Suds or Bubble Test on page 1-31*
   - *Tracing Powder or Chalk Test on page 1-30*

Maintenance and Lubrication

Specifications

Approximate Fluid Capacities

The following approximate capacities are given in US English and metric conversions. Refer to *Fluid and Lubricant Recommendations on page 1-32* for more information. All capacities are approximate. When adding, be sure to fill to the approximate level as recommended in this manual. Recheck fluid level after filling.

Application	Specification	
	Metric	US English
Cooling Systems		
Heater Cooling	1.9 L	2.01 qt
High Voltage Battery Cooling	6.18 L	6.53 qt
Power Electronics Cooling	2.4 L	2.54 qt

Fluid and Lubricant Recommendations

The Recommended Fluids and Lubricants information will be found in the Owner's Manual. Refer to the Maintenance Schedule subsection of the Owner's Manual.

You may be able to use the Search information function using the words Fluids or Lubricants.

Most transmission, transfer case, front and rear axle lubricant recommendations will be found in those service categories (subsections).

Maintenance Items

Maintenance Procedure	Link
Approximate Fluid Capacities	*Approximate Fluid Capacities on page 1-32*
Fluid and Lubricant Recommendations	*Fluid and Lubricant Recommendations on page 1-32*
Maintenance Replacement Parts	*Maintenance Replacement Parts on page 1-32*
Tire Pressure Indicator Sensor Learn	*Tire Pressure Indicator Sensor Learn on page 15-44*
Passenger Compartment Air Filter Replacement	*Passenger Compartment Air Filter Replacement on page 10-57*
Brake Pad Inspection	*Brake Pad Inspection on page 5-100*
Hydraulic Brake System Bleeding	*Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*
Automatic Transmission Fluid Drain and Fill - 1ET35	*Transmission Fluid Drain and Fill on page 16-42* - 1ET35

Maintenance Replacement Parts

Replacement parts identified below by name, part number, or specification can be obtained from your dealer.

Maintenance Replacement Parts

Part	GM Part Number	ACDelco Part Number
Passenger Compartment Air Filter	13271190	CF181

Maintenance Replacement Parts (cont'd)

Part	GM Part Number	ACDelco Part Number
Wiper Blades		
Driver Side – 60 cm (23.6 in)	95108156	—
Passenger Side – 40 cm (15.7 in)	95108153	—
Rear	96688389	—

Maintenance

Maintenance Schedule

The Maintenance Schedule information will only be found in the Owner's Manual.

Refer to the Maintenance Schedule subsection of the Owner's Manual, or you may be able to use the search information function using the words Scheduled Maintenance.

GM Oil Life System Resetting

When the system has calculated that oil life has been diminished, it will indicate that an oil change is necessary. A CHANGE ENGINE OIL SOON message will come on. Change the engine oil as soon as possible within the next 600 miles (1 000 km). It is possible that, if driving under the best conditions, the oil life system may not indicate that an oil change is necessary for over a year. However, the engine oil and filter must be changed at least once a year and at this time the system must be reset.

If the system is ever reset accidentally, change the engine oil at 3,000 miles (5 000 km) since last oil change.

Manual Oil Life System Reset

1. Turn the ignition key to ON/RUN, with the engine OFF.
2. Press the DIC MENU button on the turn signal lever to enter the Vehicle Information Menu. Use the thumbwheel to scroll through the menu items until you reach REMAINING OIL LIFE.
3. Press the SET/CLR button to reset the oil life at 100%
4. Turn the ignition to LOCK/OFF.

The system is reset when the CHANGE ENGINE OIL SOON message is off and the REMAINING OIL LIFE 100% message is displayed.

If the CHANGE OIL SOON message comes back on when you start the vehicle, the Engine Oil Life System has not reset. Repeat the procedure.

Automatic Oil Life System Reset

1. Turn on the ignition
2. Connect scan tool
3. Select Module Diagnosis
4. Select Engine Control Module
5. Select Configuration/Reset function
6. Select Engine Oil System Reset
7. Push Enter button to run function
8. Confirm Executed successfully
9. Turn ignition off and confirm
10. Turn ignition on and confirm

Squeaks and Rattles

Diagnostic Information and Procedures

Squeaks and Rattles

Note: Squeaks and rattles are caused by improperly controlled relative motion between vehicle components. There are 4 ways to prevent squeaks and rattles.

- Attach the component that squeaks or rattles securely.
- Separate the components that squeak or rattle to prevent contact.
- Insulate the components that squeak or rattle.
- Insulate low uniform friction surfaces to eliminate stickslip motion.

Symptoms - Squeaks and Rattles

Rattle Coming From the Side Rail

Checks	Action
Check the brake lines.	• Tap lightly on the brake lines and listen for a rattle. • Install plastic tie straps to secure the brake lines tightly together.

Rattle Under Vehicle at Higher RPM

Checks	Action
Check for heat shield contact with the underbody.	• Raise the vehicle and perform a visual inspection. • Bend the heat shield slightly to gain clearance from the underbody.

Thump From Rear of Vehicle on Bumps

Checks	Action
Check for a properly secured spare tire or tire repair kit in the rear compartment.	• Open the rear compartment and perform a visual inspection of the spare tire or the tire repair kit and the tools. • Tightly secure the spare tire or the tire repair kit and all tools. • Perform a road test to verify that the noise is eliminated.

Glass Knock Coming From the Rear of the Vehicle When Driving Over Bumps

Checks	Action
Check for an out-of-adjustment hatchback latch.	• Test drive the vehicle in order to verify this condition. • Loosen the latch nuts and adjust the latch downward.

Rattle Coming From Door

Checks	Action
Check for rattling electrical connectors inside the door trim panel.	• Tap on the trim panel and listen for a rattle. • Remove the trim panel and wrap foam padding around the connectors as required.

Squeak When Operating Doors

Checks	Action
Check for a lack of lubrication of the door hinge pins.	• Operate the doors and listen for squeaks. • Lubricate the door hinge pins with light oil and coat with lithium grease.

Squeak Coming From Console When Shifting Manual Transmission Condition Occurs In Cold Weather with a Cold Engine

Checks	Action
Check the manual transaxle control lever lower boot.	• Move the control lever between gears and listen for squeaks. • Remove the floor console and replace the lower shift boot or apply talcum powder to the lower shift boot.

Buzz From the Left Side of Instrument Panel

Checks	Action
Check for vibration of the fuse box cover against the instrument panel side trim.	• Tap on the cover with a finger and listen for a buzz. • Apply felt pads to the side trim where the cover makes contact.

Squeak Coming From Instrument Cluster Trim Plate

Checks	Action
Check for rubbing the cluster trim plate on the instrument panel.	• Test drive the vehicle in order to verify this condition. • Remove the instrument cluster trim plate and install felt tape to the edges.

Special Tools and Equipment

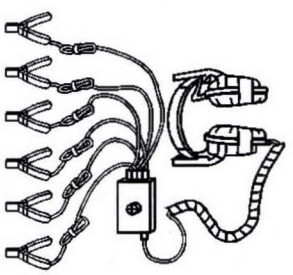
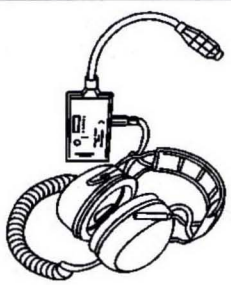
Illustration	Tool Number/ Description
 643842	CH-39570 J-39570 Chassis Ear

Illustration	Tool Number/ Description
 69758	GE-41416 J-41416 Ultrasonic Leak Detector

Vibration Diagnosis and Correction

Specifications

Tire and Wheel Runout Specifications

Application	Specification	
	Metric	English
Tire and Wheel Assembly– Lateral and Radial		
Off-Vehicle	1.27 mm	0.050 in
On-Vehicle	1.52 mm	0.060 in
Wheel, Aluminum		
Lateral	0.762 mm	0.030 in
Radial	0.762 mm	0.030 in
Wheel, Steel		
Lateral	1.143 mm	0.045 in
Radial	1.015 mm	0.040 in
Wheel Hub/Axle Flange– Guideline	0.132 mm	0.0052 in
Wheel Stud– Guideline	0.25 mm	0.010 in

Diagnostic Information and Procedures

Vibration Diagnosis, Starting Point, and Correction

The information contained in this Vibration Diagnosis and Correction section is designed to cover various vehicle designs and configurations. Not all content will apply to all vehicles.

Note: The following steps must be completed before using the analysis tables or the symptom tables.

1. Perform the *Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer) on page 1-37* or *Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope) on page 1-39* table before using the other Vibration Analysis tables or the Symptom tables in order to effectively diagnose the customer's concern.

   The use of Vibration Analysis - Road Testing will first provide duplication of virtually any vibration concern and then identify the correct procedure for diagnosing the area of concern which has been duplicated.
2. Review the following Vibration Diagnostic Process.
3. Review the general descriptions to familiarize yourself with vibration theory and terminology, the *CH-51450-NVH* Oscilloscope Diagnostic Kit (w/ NVH), or the *EL-38792–A* Electronic Vibration Analyzer (EVA) 2, and the *EL-38792–VS* Vibrate Software. Reviewing this information will help you determine whether the condition described by the customer is a potential operating characteristic or not.

   Refer to the following:
   - *Vibration Theory and Terminology on page 1-65*
   - *Oscilloscope Diagnostic Kit Description and Operation on page 1-75*
   - *Electronic Vibration Analyzer (EVA) Description and Operation on page 1-73*
   - *Vibrate Software Description and Operation on page 1-81*
   - *Reed Tachometer Description on page 1-81*

Vibration Diagnostic Process

Note: Using the following steps of the vibration diagnostic process will help you to effectively narrow-down and pin-point the search for the specific source of a vibration concern and to arrive at an accurate repair.

1. Gather specific information on the customer's vibration concern.
2. Perform the road testing steps in sequence as identified in Vibration Analysis - Road Testing in order to duplicate the customer's concern and evaluate the symptoms of the concern under changing conditions. Observe what the vibration feels like and what it sounds like. Observe when the symptoms first appear, when they change, and when they cease.
3. Determine if the customer's vibration concern is truly an abnormal condition or something that is potentially an operating characteristic of the vehicle.
4. Systematically eliminate or “rule-out” possible vehicle systems.
5. Focus diagnostic efforts on the remaining vehicle system and systematically eliminate or “rule-out” possible components of that system.

6. Make a repair on the remaining component, or components, which have not been eliminated systematically, and must therefore be the cause of the vibration.
7. Verify that the customer's concern has been eliminated or at least brought to an acceptable level.
8. Again perform the road testing steps in sequence as identified in Vibration Analysis - Road Testing in order to verify that the vehicle did not have more than one vibration occurring.

Preliminary Visual/Physical Inspection

- Inspect for aftermarket equipment and modifications which could affect the operation of the vehicle rotating component systems.
- Inspect the easily accessible or visible components of the vehicle rotating component systems for obvious damage or conditions which could cause the symptom.
- Inspect the tire inflation pressures for the proper pressure.

Diagnostic Aids

Improper component routing or isolation, or components which are worn or faulty may be the cause of intermittent conditions that are difficult to duplicate. If the vibration concern could not be duplicated by following the steps of the Vibration Diagnostic Process, refer to *Vibration Diagnostic Aids on page 1-48*.

Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)

Special Tools

EL-38792-A Electronic Vibration Analyzer (EVA) 2

For equivalent regional tools, refer to *Special Tools and Equipment on page 1-82*.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

5. Obtaining rotational speed for the components rotating at tire/wheel speed is critical to systematically eliminating specific vehicle component groups. These component rotational speeds can be generated by using an electronic vibration analyzer, or through calculating them manually.

Note: Be certain to OBSERVE for disturbances that match the customer's description FIRST, then look at the vibration analyzer frequency which corresponds with that disturbance.

9. Proper location of the vibration analyzer sensor onto the component which is most excited by the vibration disturbance is critical to obtaining an accurate frequency reading.

   This test will duplicate virtually any disturbance which occurs while the vehicle is in motion.
10. Accelerate to a speed high enough above the speed of the disturbance to allow for the time needed to shift into NEUTRAL before coasting down through the disturbance range.

Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)

Step	Action	Yes	No
1	Did you review the Diagnostic Starting Point – Vibration Diagnosis?	Go to *Step 2*	Go to *Diagnostic Starting Point - Vehicle on page 6-90*
2	Did the customer concern indicate that the vibration occurs ONLY while the vehicle is standing still?	Go to *Step 6*	Go to *Step 3*
3	Visually inspect the tire and wheel assemblies, steering components and suspension components for any possible faults. Are the tire and wheel assemblies, steering components and suspension components in good working condition?	Go to *Step 5*	Go to *Step 4*
4	**Note:** Do NOT operate the vehicle until the faults are corrected. Correct the faults with the tire and wheel assemblies, steering components, and/or the suspension components before proceeding. Did you correct the faults with the tire and wheel assemblies, steering components, and/or the suspension components?	Go to *Step 5*	Go to *Step 3*
5	1. Obtain the drive axle final drive ratio. 2. If the vibration analyzer has suitable software, obtain the transmission gear ratios. 3. If the a vibration analyzer is not available, take note of the tire size on each axle, then calculate the tire rotational speed for each size tire used. Refer to *Component Rotational Speed Calculation on page 1-41*. Did you obtain the powertrain ratios for use with the vibration analyzer , or calculate the component rotational speeds, if a vibration analyzer is NOT available?	Go to *Step 6*	—

Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer) (cont'd)

Step	Action	Yes	No
6	1. Install a scan tool. 2. With the scan tool, bring up the Powertrain Control Module data list. Is the scan tool operating properly?	Go to *Step 7*	Go to *Diagnostic Starting Point - Vehicle on page 6-90*
7	Using a vibration analyzer is the preferred method for gathering necessary vibration frequency data. If a vibration analyzer is not available, the necessary vibration frequency data will have to be obtained based on symptoms observed during testing. Review *Symptoms - Vibration Diagnosis and Correction on page 1-50* to become familiar with the possible frequency ranges. Review Symptoms – Vibration Diagnosis and Correction, as necessary throughout the remainder of diagnostics. Is a vibration analyzer available for use?	Go to *Step 8*	—
8	Install the *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2). Is the vibration analyzer operating properly?	Go to *Step 9*	Go to *Electronic Vibration Analyzer (EVA) Description and Operation on page 1-73*
9	1. Install the vibration analyzer sensor, if available, to the component identified by the customer as most respondent to the vibration. If no component was identified, install the vibration analyzer sensor, if available, to the steering column. You may have to move the sensor to other locations later. 2. Select a smooth, level road and slowly accelerate the vehicle up to highway speed. 3. Observe the vehicle for disturbances that match the customer's description and note the following conditions: • The vehicle speed • The transmission gear range and the specific gear • The vibration frequency reading, if detected by the vibration analyzer • The feel and/or sound of the disturbance 4. If the vibration seems to excite a particular component of the vehicle more than the steering column, then move the vibration analyzer sensor, if available, onto that component and repeat steps 2 and 3. Were you able to duplicate the customer's concern?	Go to *Step 10*	Go to *Vibration Diagnostic Aids on page 1-48*
10	1. Accelerate the vehicle to a speed higher than the speed at which the disturbance occurs. **Note:** Let the vehicle coast to a stop before shifting back into gear. 2. Shift the vehicle into NEUTRAL and allow the vehicle to coast down through the disturbance range. Does the disturbance still occur while coasting-down in NEUTRAL?	Go to *Step 12*	Go to *Step 11*
11	1. Select a smooth, level road and slowly accelerate the vehicle up to the speed at which the disturbance occurs. 2. Decelerate and safely downshift by one gear range. 3. Operate the vehicle at the same VEHICLE SPEED at which the disturbance occurs. Does the same disturbance still occur while going the same vehicle speed in a lower gear range?	Go to *Vibration Analysis - Hub and/or Axle Input on page 1-46*	Go to *Symptoms - Vibration Diagnosis and Correction on page 1-50*
12	If the vibration analyzer is not available, refer to *Symptoms - Vibration Diagnosis and Correction on page 1-50*. Did the vibration analyzer detect a dominant frequency?	Go to *Step 13*	Go to *Symptoms - Vibration Diagnosis and Correction on page 1-50*

Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer) (cont'd)

Step	Action	Yes	No
13	1. If the vibration analyzer HAS the features, use the drive axle final drive ratio, and the specific transmission gear ratio to make a comparison to the dominant frequency reading recorded. 2. If the vibration analyzer does NOT have the features, compare the dominant frequency reading recorded to the component rotational data which you calculated previously. Does the frequency data clearly fall within the tire/wheel parameters ONLY?	Go to *Vibration Analysis - Tire and Wheel on page 1-43*	Go to *Symptoms - Vibration Diagnosis and Correction on page 1-50*

Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)

Special Tools

- *CH-51450-NVH* Oscilloscope Diagnostic Kit (w/NVH)
- *EL-47955* Multi Diagnostic Interface (MDI)

For equivalent regional tools, refer to *Special Tools and Equipment on page 1-82*.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

Note: Be certain to OBSERVE for disturbances that match the customers description FIRST, then look at the *CH-51450-NVH* Oscilloscope Diagnostic Kit (w/ NVH) frequency which corresponds with that disturbance.

8. Proper location of the *CH-51450-NVH* oscilloscope accelerometer onto the component which is most excited by the vibration disturbance is critical to obtaining an accurate frequency reading.

   This test will duplicate virtually any disturbance which occurs while the vehicle is in motion.
9. Accelerate to a speed high enough above the speed of the disturbance to allow for the time needed to shift into NEUTRAL and for the engine to decrease in RPM to idle speed before coasting down through the disturbance range.
10. This test will either eliminate or confirm the engine as a contributing cause of the customer concern.

Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)

Step	Action	Yes	No
1	Did you review the Diagnostic Starting Point – Vibration Diagnosis?	Go to *Step 2*	Go to *Diagnostic Starting Point - Vehicle on page 6-90*
2	Did the customer concern indicate that the vibration occurs ONLY while the vehicle is standing still?	Go to *Step 6*	Go to *Step 3*
3	Visually inspect the tire and wheel assemblies, steering components and suspension components for any possible faults. Are the tire and wheel assemblies, steering components and suspension components in good working condition?	Go to *Step 5*	Go to *Step 4*
4	**Note:** Do NOT operate the vehicle until the faults are corrected. Correct the faults with the tire and wheel assemblies, steering components, and/or the suspension components before proceeding. Did you correct the faults with the tire and wheel assemblies, steering components, and/or the suspension components?	Go to *Step 5*	Go to *Step 3*
5	Obtain the drive axle final drive ratio. Did you obtain the drive axle final drive ratio?	Go to *Step 6*	—
6	Install the *CH-51450-NVH* Oscilloscope and the *EL-47955* MDI. Is the *CH-51450-NVH* Oscilloscope operating properly?	Go to *Step 7*	*Oscilloscope Diagnostic Kit Description and Operation on page 1-75*

Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope) (cont'd)

Step	Action	Yes	No
7	1. Install the *CH-51450-NVH-TA183* accelerometer to the pinion area of the drive axle. Route the accelerometer cable clear of rotating parts and loosely secure the wire clear of moving parts. If it is not possible to install the *CH-51450-NVH-TA183* accelerometer to the drive axle, install the accelerometer to an exposed portion of the floor panel or seat track in the area that the customer noted is most respondent to the vibration. 2. Select a smooth, level road. 3. With the vehicle at a stand-still, apply the brake pedal and place the transmission in the lowest forward gear. **Note:** Do not accelerate to the point of causing the drive wheels to squeal, slip, or hop. This would obscure the results of the test. 4. Release the brake pedal and accelerate aggressively to 32 km/h (20 mph). 5. Observe the vehicle for disturbances that match the customers description and note the following conditions: • The vibration frequency reading, if detected, by the *CH-51450-NVH* Oscilloscope • The feel and/or sound of the disturbance 6. If a reading could not be obtained by the *CH-51450-NVH* Oscilloscope, move the *CH-51450-NVH-TA183* accelerometer to another part that is respondent to the vibration and repeat Steps 3-5. Were you able to duplicate the customer concern?	Go to *Vibration Analysis - Hub and/or Axle Input on page 1-46*	Go to *Step 8*
8	1. Install the *CH-51450-NVH-TA183* accelerometer to the component identified by the customer as most respondent to the vibration. If no component was identified, install the *CH-51450-NVH-TA183* accelerometer to the drivers side right seat rail. You may have to move the sensor to other locations later. 2. Select a smooth, level road and slowly accelerate the vehicle up to highway speed. 3. Observe the vehicle for disturbances that match the customers description and note the following conditions or take a snapshot using the *CH-51450-NVH* software: • The vehicle speed • The engine RPM • The transmission gear range and the specific gear • The vibration frequency reading, if detected, by the *CH-51450-NVH* Oscilloscope • The feel and/or the sound of the disturbance 4. If the vibration seems to excite a particular component of the vehicle more than the sear rail, move the *CH-51450-NVH-TA183* accelerometer onto that component and repeat Steps 2 and 3. Were you able to duplicate the customer concern?	Go to *Step 9*	Go to *Vibration Diagnostic Aids on page 1-48*
9	1. Accelerate the vehicle to a speed higher than the speed at which the disturbance occurs. **Note:** If the vehicle is equipped with a continuously variable type automatic transmission, let the vehicle coast to a stop before shifting back into gear. 2. Shift the vehicle into NEUTRAL and allow the vehicle to coast down through the disturbance range. Does the disturbance still occur while coasting down in NEUTRAL?	Go to *Step 11*	Go to *Step 10*
10	1. Select a smooth, level road and slowly accelerate the vehicle up to the speed at which the disturbance occurs. 2. Decelerate and safely downshift by one gear range. 3. Operate the vehicle at the same VEHICLE SPEED at which the disturbance occurs. Does the same disturbance still occur while going the same vehicle speed in a lower gear range?	Go to *Vibration Analysis - Hub and/or Axle Input on page 1-46*	Go to *Symptoms - Vibration Diagnosis and Correction on page 1-50*

Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope) (cont'd)

Step	Action	Yes	No
11	If the *CH-51450-NVH* Oscilloscope is not available, refer to *Symptoms - Vibration Diagnosis and Correction on page 1-50*. Did the *CH-51450-NVH* Oscilloscope detect a dominant frequency?	Go to *Step 12*	Go to *Symptoms - Vibration Diagnosis and Correction on page 1-50*
12	Does the frequency data clearly fall within the tire/wheel parameters ONLY?	Go to *Vibration Analysis - Tire and Wheel on page 1-43*	Go to *Symptoms - Vibration Diagnosis and Correction on page 1-50*

Component Rotational Speed Calculation

Special Tools

- *CH-51450-NVH* Oscilloscope Diagnostic Kit (w/NVH)
- *EL-38792-A* Electronic Vibration Analyzer (EVA) 2
- *EL-47955* Multi Diagnostic Interface (MDI)

For equivalent regional tools, refer to *Special Tools and Equipment on page 1-82*.

Note: If using the *CH-51450-NVH* Oscilloscope Diagnostic Kit (w/NVH), the component rotation is integrated into the tool. The diameter of the pulley will need to be measured and manually entered into the NVH software.

Tire Rotational Speed

Determining Tire Revolutions Per Second at 8 km/h (5 mph) — Using EVA

Tire and wheel assembly rotational speed can be obtained through using the *EL-38792-A* Electronic Vibration Analyzer (EVA) 2. Perform the following steps using the *EL-38792-A* Electronic Vibration Analyzer (EVA) 2 to obtain the rotational speed at 8 km/h (5 mph). Use the Enter key to advance and the Exit key to backup.

1. On the Main Menu screen, select Auto Mode.
2. On the Suspected Source screen, select Vehicle Speed.
3. On the Tire Info Source screen, select Manual Entry.
4. On the Tire Width screen, enter the specific width of the tires.

   For example: For a P245/45/R18 tire, enter 245.
5. On the Aspect Ratio screen, enter the specific aspect ratio of the tires.

   For example: For a P245/45/R18 tire, enter 0.45.
6. On the Rim Diameter screen, enter the specific rim diameter size.

   For example: For a P245/45/R18 tire, enter 18.0.
7. On the Driveshaft Configuration screen, enter FWD, even if the vehicle is a rear wheel drive.
8. The next screen will display the tire size just entered for confirmation.

   For example: 245 0.45 18.0 –Front Wheel Drive. If the tire size displayed is correct, press Enter.
9. On the Vehicle Speed Units screen, press Enter, disregard mph or km/h.
10. Press the Exit key several times slowly while watching the backwards progression of the screens. Stop at the Tire Info Source screen.
11. On the Tire Info Source screen, select RPS at 5 mph.
12. The next screen will display the revolutions per second (RPS) at 8 km/h (5 mph) for that specific tire size.

    For example: The P245/45/R18 will display 1.08 RPS.

Calculating Tire Revolutions Per Second at 8 km/h (5 mph) - Without Ocilloscope or EVA

If the *EL-38792-A* Electronic Vibration Analyzer (EVA) 2 is not available, the tire and wheel assembly rotational speed can be calculated approximately by performing the following steps.

1. Convert the rim diameter size from inches to centimeters.

   For example: For a P245/45/R18 tire, the rim diameter of 18 in X 2.54 converts to 45.72 cm.
2. Calculate the radius of the rim by dividing the rim diameter by 2.

   For example: For a P245/45/R18 tire, the rim diameter of 18 is converted to 45.72 cm divided by 2 = rim radius 22.86 cm.
3. Calculate the approximate tire sidewall height by multiplying the specific tire tread width by the aspect ratio, then reduce 7 percent from the amount by multiplying by 93 percent to approximate load on the tire reducing the sidewall height.

   For example: For a P245/45/R18 tire, tread width 245 mm X aspect ratio as a decimal 0.45 = 110 mm X 0.93 = approximate sidewall height 102.30 mm.
4. Convert the calculated approximate tire sidewall height from millimeters to centimeters.

   For example: For a P245/45/R18 tire, approximate sidewall height 102.30 mm converts to 10.23 cm.
5. Calculate the approximate tire and wheel assembly radius by adding the rim radius and approximate sidewall height, both in cm.

   For example: For a P245/45/R18 tire, rim radius 22.86 cm + 10.23 cm = approximate tire and wheel assembly radius 33.09 cm.
6. Calculate the approximate circumference of the tire and wheel assembly by multiplying 2 X pi, or 6.283185 X the approximate tire and wheel assembly radius.

For example: For a P245/45/R18 tire, 6.283185 X approximate tire and wheel assembly radius 33.09 cm = approximate tire and wheel assembly circumference 207.911 cm.

7. Calculate the approximate revolutions per kilometer by dividing the number of cm in 1 km, 100,000 cm by the approximate tire and wheel assembly circumference.

   For example: For a P245/45/R18 tire, 100,000 cm divided by approximate tire and wheel assembly circumference 207.911 cm = approximate revolutions per kilometer 480.975.

8. Calculate the approximate revolutions per second (RPS), or Hz, by dividing the approximate revolutions per kilometer by the number of seconds to travel 1 km at a speed of 8 km per hour, 450 seconds.

   For example: For a P245/45/R18 tire, approximate revolutions per kilometer 480.975 divided by the number of seconds to travel 1 km at a speed of 8 km per hour, 450 seconds = approximate RPS, or Hz 1.069 rounded to 1.07.

Calculating Tire Revolutions Per Second, or Hz at Concern Speed

A size P235/75R15 tire rotates ONE complete revolution per second (RPS), or 1 Hz, at a vehicle speed of 8 km/h (5 mph). This means that at 16 km/h (10 mph), the same tire will make TWO complete revolutions in one second, 2 Hz, and so on.

1. Determine the rotational speed of the tires in revolutions per second (RPS), or Hertz (Hz), at 8 km/h (5 mph), based on the size of the tires. Refer to the preceding Tire Rotational Speed information.

   For example: According to the Tire Rotational Speed information, a P245/45R18 tire makes 1.08 revolutions per second (Hz) at a vehicle speed of 8 km/h (5 mph). This means that for every increment of 8 km/h (5 mph) in vehicle speed, the tire's rotation increases by 1.08 revolutions per second, or Hz.

2. Determine the number of increments of 8 km/h (5 mph) that are present, based on the vehicle speed in km/h (mph) at which the disturbance occurs.

   For example: Assume that a disturbance occurs at a vehicle speed of 96 km/h (60 mph). A speed of 96 km/h (60 mph) has 12 INCREMENTS of 8 km/h (5 mph):

   96 km/h (60 mph) divided by 8 km/h (5 mph) = 12 increments

3. Determine the rotational speed of the tires in revolutions per second, or Hz, at the specific vehicle speed in km/h (mph) at which the disturbance occurs.

   For example: To determine the tire rotational speed at 96 km/h (60 mph), multiply the number of increments of 8 km/h (5 mph) by the revolutions per second, or Hz, for one increment:

   12 increments X 1.08 Hz = 12.96 Hz, rounded to 13 Hz

   Note: If the *EL-38792-A* Electronic Vibration Analyzer (EVA) 2 is not available, compare the calculated rotational speed to the frequency range associated with the symptoms of the vibration concern. Refer to *Symptoms - Vibration Diagnosis and Correction on page 1-50*.

4. Compare the rotational speed of the tires at the specific vehicle speed at which the disturbance occurs, to the dominant frequency recorded on the *EL-38792-A* Electronic Vibration Analyzer (EVA) 2 during testing. If the frequencies match, then a first-order disturbance related to the rotation of the tire/wheel assemblies is present.

   If the frequencies do not match, then the disturbance may be related to a higher order of tire/wheel assembly rotation.

5. To compute higher order tire/wheel assembly rotation related disturbances, multiply the rotational speed of the tires at the specific vehicle speed at which the disturbance occurs, by the order number:

   13 Hz X 2, for second order = 26 Hz second-order tire/wheel assembly rotation related

   13 Hz X 3, for third order = 39 Hz third-order tire/wheel assembly rotation related

   If any of these computations match the frequency of the disturbance, a disturbance of that particular order, relating to the rotation of the tire/wheel assemblies and/or driveline components, also rotating at the same speed, is present.

Component Rotational Speed Worksheet

Utilize the following worksheet as an aid in calculating the first, second and third order of tire/wheel assembly rotational speed related disturbances that may be present in the vehicle.

If after completing the Tire/Wheel Rotation Worksheet, the frequencies calculated do NOT match the dominant frequency of the disturbance recorded during testing, either recheck the data, or attempt to rematch the figures allowing for 1½–8 km/h (1–5 mph) of speedometer error.

If the possible tire/wheel assembly rotational speed related frequencies still do not match the dominant frequency of the disturbance, the disturbance is most likely torque/load sensitive.

If after completing the Tire/Wheel Rotation Worksheet, one of the frequencies calculated DOES match the dominant frequency of the disturbance, the disturbance is related to the rotation of that component group – tire/wheel assembly related.

TIRE/WHEEL ROTATION WORKSHEET

Vehicle Information

Complaint Speed: _____ mph
Year: _____ Model: _____
Symptom: _____
VIN: _____
Frequency: _____
Engine: _____ Trans: _____
Engine Speed: _____ rpm
Tire Size: _____ Axle Ratio: _____ : ___
Gear: _____
TPC Spec: _____

Tire/Wheel Speed

Vibration Occurs at:	[ ]	mph ÷ 8 (km/h) 5 (mph)		=	[ ]	increments of 8 km/h / 5 mph
						Tire/Wheel Speed, RPS (Hz)
8 km/h / 5 mph increments	[ ]	x	[ ] tire RPS * at 8 km/h / 5 mph (from table)	=	[ ]	**1st order**
1st order	[ ]	x 2		=	[ ]	**2nd order**
1st order	[ ]	x 3		=	[ ]	**3rd order**

*RPS revolutions per second; equates to cycles per second (Hz).

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Vibration Analysis - Tire and Wheel

Test Description

The numbers below refer to the step numbers in the diagnostic table:

4. A build-up of foreign material on a tire and wheel assembly and/or a damaged, abnormally or excessively worn tire and wheel assembly could cause a vibration disturbance.
6. Tire and wheel assemblies that exhibit excessive runout when measured while mounted on the vehicle, may or may not be contributing to, or causing a vibration disturbance. On-vehicle runout, if present, could contribute to, or cause a vibration disturbance, but the cause of the on-vehicle runout may not be the tire and wheel assemblies.
7. Tire and wheel assemblies that exhibit excessive runout when measured off of the vehicle could cause a vibration disturbance.
9. Tire and wheel assemblies that exhibit marginal runout—within acceptable limits, but close to the maximum—when measured off of the vehicle could still be contributing to a vibration disturbance, if its mating hub/axle flange also exhibits marginal runout. When the tire and wheel assembly and the hub axle flange are mounted to each other, the combined stack-up of their marginal amounts of runout could combine to produce an excessive amount of runout, which could cause a vibration disturbance.
14. Brake rotors and/or brake drums, if equipped, that exhibit excessive imbalance could contribute to, or possibly cause a vibration disturbance.
15. A hub/axle flange and/or wheel studs that exhibit excessive runout could cause a vibration disturbance.
16. When the tire and wheel assembly and the hub axle flange are mounted to each other, the combined stack-up of their marginal amounts of runout could combine to produce an excessive amount of runout, which could cause a vibration

disturbance. Match-mounting or vectoring the tire and wheel assembly to the hub/axle flange will modify the amount of combined runout.

18. Force variation may be present in a tire and wheel assembly that exhibited acceptable balance and runout. Force variation, if present, could contribute to, or cause a vibration disturbance.
20. Vibration disturbances could be affected by, or possibly caused by, components that are susceptible to steering input and/or torque-load input.
22. On-vehicle balancing, or finish-balancing can be used to reduce small amounts of imbalance which may be present as a result of the combined stack-up of the tire and wheel assembly with other components which may exhibit marginal balance.

Vibration Analysis - Tire and Wheel

Step	Action	Yes	No
1	Has the Vibration Analysis – Road Testing table been completed?	Go to *Step 2*	Go to *Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer) on page 1-37* or *Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope) on page 1-39*
2	Based on the Vibration Analysis – Road Testing table, is the concern first-order tire and wheel assembly related?	Go to *Step 4*	Go to *Step 3*
3	Based on the Vibration Analysis – Road Testing table, is the concern second-order, or higher-order tire and wheel assembly related?	Go to *Step 18*	Go to *Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer) on page 1-37* or *Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope) on page 1-39*
4	Visually inspect the tire and wheel assemblies for the following: • Debris build-up, such as packed mud, undercoating, ice/snow buildup, road tar, etc. • Damage, abnormal or excessive wear Refer to *Tire and Wheel Inspection on page 1-52*. Do any of the tire and wheel assemblies exhibit any of the conditions listed?	Go to *Step 5*	Go to *Step 6*
5	1. Remove the debris from the tire and wheel assemblies. 2. Replace the damaged, abnormally or excessively worn wheels or tires as necessary. Did you complete the repair or replacement?	Go to *Step 23*	—
6	Measure the on-vehicle runout of the tire and wheel assemblies. Refer to *Tire and Wheel Assembly Runout Measurement - On-Vehicle on page 1-53*. Does the runout measurement indicate a runout concern?	Go to *Step 7*	Go to *Step 12*
7	Measure the off-vehicle runout of the tire and wheel assemblies. Refer to *Tire and Wheel Assembly Runout Measurement - Off Vehicle on page 1-54*. Does the runout measurement indicate a runout concern?	Go to *Step 19*	Go to *Step 8*
8	Is the vehicle equipped with run-flat tires?	Go to *Step 12*	Go to *Step 9*
9	Are any of the tire and wheel assembly runout measurements marginal; within acceptable limits, but close to the maximum?	Go to *Step 10*	Go to *Step 15*

Vibration Analysis - Tire and Wheel (cont'd)

Step	Action	Yes	No
10	**Note:** Ensure that each tire and wheel assembly that is match-mounted is properly balanced before reinstalling to the vehicle. 1. Match-mount the tire-to-wheel for each tire and wheel assembly with marginal runout. Refer to *Tire-to-Wheel Match-Mounting (Vectoring) on page 1-63*. 2. Measure the runout of each match-mounted tire and wheel assembly. Refer to *Tire and Wheel Assembly Runout Measurement - Off Vehicle on page 1-54*. Were you able to significantly reduce the amount of tire and wheel assembly runout?	Go to *Step 11*	Go to *Step 19*
11	Re-measure the on-vehicle runout of the tire and wheel assemblies. Refer to *Tire and Wheel Assembly Runout Measurement - On-Vehicle on page 1-53*. Does the measurement indicate a runout concern?	Go to *Step 15*	Go to *Step 23*
12	Inspect the balance of the tire and wheel assemblies. Refer to *Tire and Wheel Assembly Balancing - Off Vehicle on page 1-59*. Are any or the tire and wheel assemblies out of balance?	Go to *Step 13*	Go to *Step 14*
13	Balance the tire and wheel assemblies as necessary. Refer to *Tire and Wheel Assembly Balancing - Off Vehicle on page 1-59*. Were you able to achieve balance?	Go to *Step 23*	Go to *Vibration Diagnostic Aids on page 1-48*
14	1. Inspect the brake rotors and brake drums, if equipped, for damage. 2. Inspect the balance of the brake rotors and brake drums, if equipped. Refer to *Brake Rotor/Drum Balance Inspection on page 1-57*. 3. Replace brake rotors and/or brake drums, if equipped, that are damaged and/or out of balance. Did you find and correct a condition?	Go to *Step 23*	Go to *Step 17*
15	1. Measure the runout of the hub/axle flanges and the wheel studs, if equipped. 2. Inspect the wheel bolts, if equipped, for straightness and damage. 3. Refer to *Hub/Axle Flange and Wheel Stud Runout Inspection on page 1-57*. 4. If the inspection procedure indicates a runout concern, replace the appropriate components: • Wheel studs, if equipped • Wheel bolts, if equipped • Wheel bearing/hub assembly Did you find and correct a condition?	Go to *Step 23*	Go to *Step 16*
16	1. Match-mount the tire and wheel assemblies-to-hub/axle flanges. Refer to *Tire and Wheel Assembly-to-Hub/Axle Flange Match-Mounting on page 1-64*. 2. Re-measure the on-vehicle runout of tire and wheel assemblies. Refer to *Tire and Wheel Assembly Runout Measurement - On-Vehicle on page 1-53*. Were you able to significantly reduce the amount of on-vehicle tire and wheel assembly runout?	Go to *Step 23*	Go to *Step 2*
17	Inspect for radial and lateral force variation. Refer to *Tire and Wheel Assembly Isolation Test on page 1-58*. Were you able to isolate one or more of the tire and wheel assemblies as the cause of the disturbance?	Go to *Step 19*	Go to *Step 20*
18	Inspect for radial and lateral force variation. Refer to *Tire and Wheel Assembly Isolation Test on page 1-58*. Were you able to isolate one or more of the tire and wheel assemblies as the cause of the disturbance?	Go to *Step 19*	Go to *Step 21*

Vibration Analysis - Tire and Wheel (cont'd)

Step	Action	Yes	No
19	Replace any tires and/or wheels that were isolated as the cause of the disturbance, as necessary. Did you complete the replacement?	Go to *Step 23*	—
20	Perform the Vibration Analysis – Hub/Axle Input table. Refer to *Vibration Analysis - Hub and/or Axle Input on page 1-46*. Did you find and correct a condition?	Go to *Step 23*	Go to *Step 22*
21	Perform the Vibration Analysis – Hub/Axle Input table. Refer to *Vibration Analysis - Hub and/or Axle Input on page 1-46*. Did you find and correct a condition?	Go to *Step 23*	Go to *Vibration Diagnostic Aids on page 1-48*
22	Finish-balance the tire and wheel assemblies on-vehicle. Refer to *Tire and Wheel Assembly Balancing - On-Vehicle on page 1-63*. Did you complete the on-vehicle finish balancing?	Go to *Step 23*	—
23	1. Install or connect any components that were removed or disconnected during diagnosis. 2. Perform the Vibration Analysis – Road Testing table. Refer to *Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer) on page 1-37* or *Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope) on page 1-39*. Is the vibration still present?	Go to *Step 2*	System OK

Vibration Analysis - Hub and/or Axle Input

Test Description

The numbers below refer to the step numbers on the diagnostic table:

2. This test will determine the effect of turning input on the vibration.
6. This test will determine the effect of an initial heavy torque load on the vibration.
7. Damaged or worn wheel drive shafts may cause a noise or vibration that may be transferred into the passenger compartment.
8. Damaged or worn wheel bearings may cause a noise or vibration that may be transferred into the passenger compartment.
9. Damaged or worn suspension components may cause a noise or vibration that may be transferred into the passenger compartment.
10. Damaged or worn powertrain mounts and/or exhaust mounts may cause a noise or vibration that may be transferred into the passenger compartment.
11. Incorrect trim height may cause binding and/or interference between components that may produce a vibration.

Vibration Analysis - Hub and/or Axle Input

Step	Action	Yes	No
1	Has the Vibration Analysis – Road Testing table been completed?	Go to *Step 2*	Go to *Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer) on page 1-37* or *Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope) on page 1-39*
2	1. Operate the vehicle at the speed of the vibration concern. 2. While maintaining the concern speed, drive the vehicle through slow, sweeping turns – first in one direction, then in the other direction. 3. Observe the vehicle for changes in the vibration disturbance. 4. Select a smooth, level surface, such as an empty parking lot or a remote road. 5. While maintaining the vehicle at the concern speed if possible, drive the vehicle through sharp turns; 360 degrees – first in one direction, then in the other direction. 6. Observe the vehicle for changes in the vibration disturbance. Did the characteristics of the vibration change significantly—become worse or go away—during these steps?	Go to *Step 3*	Go to *Step 6*

Vibration Analysis - Hub and/or Axle Input (cont'd)

Step	Action	Yes	No
3	Did you hear a clicking noise and/or feel a shudder during these steps?	Go to *Step 7*	Go to *Step 4*
4	Did you hear a growling noise during these steps?	Go to *Step 8*	Go to *Step 5*
5	Did you hear a popping noise during these steps?	Go to *Step 9*	Go to *Step 12*
6	1. With the vehicle at a stand-still, apply the regular brake and place the transmission in the lowest forward gear. **Note:** Do not accelerate to the point of causing the drive wheels to squeal, slip or hop—this would obscure the results of the test. 2. Release the regular brakes and accelerate aggressively to 32 km/h (20 mph). 3. Observe the vehicle for changes in the vibration disturbance. Did you feel a shudder or shaking during these steps?	Go to *Step 7*	Go to *Vibration Diagnostic Aids on page 1-48*
7	1. Inspect the wheel drive shafts, if equipped, for damage, abnormal and/or excessive wear. 2. If the inspection indicated that a wheel drive shaft is damaged, abnormally and/or excessively worn, replace the shaft. Did you find and correct a condition?	Go to *Step 12*	Go to *Step 9*
8	1. Inspect the wheel bearings for wear and/or damage. 2. Replace any of the wheel bearings found to be worn and/or damaged. Did you find and correct a condition?	Go to *Step 12*	Go to *Vibration Diagnostic Aids on page 1-48*
9	1. Inspect the following suspension components for wear, damage, looseness and/or possible contact with other vehicle components: • Struts/shock absorbers • Springs • Bushings • Insulators 2. Replace any of the suspension components found to be worn, damaged, loose and/or contacting other vehicle components. Did you find and correct a condition?	Go to *Step 12*	Go to *Step 10*
10	1. Inspect the powertrain mounts—engine, transmission, transfer case, and direct-mount differential, if equipped—and any powertrain braces for the following conditions: • Loose and/or missing fasteners • Improper alignment • Cracked, dry-rotted, and/or oil-soaked insulators • Twisted, broken, torn, and/or collapsed insulators • Bent, twisted, and/or deformed brackets 2. Replace powertrain mounts as necessary. 3. Inspect the exhaust system components for the following: • Loose and/or missing fasteners – Heat Shields – Joints and/or couplings:	Go to *Step 12*	Go to *Step 11*

Vibration Analysis - Hub and/or Axle Input (cont'd)

Step	Action	Yes	No
	Nuts, bolts, studs, clamps, straps – Bracket and/or insulator mounting • Inadequate clearance to body and/or chassis components Inspect with the exhaust system both COLD and HOT; in NEUTRAL, FORWARD and REVERSE gears • Improper alignment • Disconnected and/or missing insulators • Cracked, dry-rotted, and/or oil-soaked insulators • Stretched, twisted, broken, torn, and/or collapsed insulators • Bent, twisted, cracked, and/or deformed brackets 4. Repair, replace, and/or realign exhaust system components as necessary. Did you find and correct a condition?		
11	Inspect the vehicle trim height and adjust as necessary. Refer to *Trim Height Inspection on page 15-35*. Did you find and correct a condition?	Go to *Step 12*	Go to *Vibration Diagnostic Aids on page 1-48*
12	1. Install or connect any components that were removed or disconnected during diagnosis. 2. Perform the Vibration Analysis – Road Testing table. Refer to *Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer) on page 1-37* or *Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope) on page 1-39*. Is the vibration still present?	Go to *Step 2*	System OK

Vibration Diagnostic Aids

Note: If you have not reviewed the Diagnostic Starting Point – Vehicle and completed the Vibration Analysis tables as indicated, refer to *Diagnostic Starting Point - Vehicle on page 6-90* BEFORE proceeding.

The diagnostic information contained in this Diagnostic Aids section will help you determine the correct course of action to take for the following 4 main conditions. Refer to the appropriate condition from this list:

- *Vibration Diagnostic Aids - Vibration Intermittent or Not Duplicated on page 1-48*
- *Vibration Diagnostic Aids - Vibration Duplicated, Component Not Identified on page 1-49*
- *Vibration Diagnostic Aids - Vibration Duplicated, Difficult to Isolate/Balance Component on page 1-50*
- *Vibration Diagnostic Aids - Vibration Duplicated, Appears to Be Potential Operating Characteristic on page 1-50*

Vibration Diagnostic Aids - Vibration Intermittent or Not Duplicated

Note: If you have not completed the Vibration Analysis tables as indicated and reviewed Vibration Diagnostic Aids, refer to *Vibration Diagnostic Aids on page 1-48* BEFORE proceeding.

If you have not been able to duplicate the vibration concern or have only been able to duplicate the concern intermittently, review the following information.

Most vibration concerns that cannot be duplicated are due to either specific conditions that are not present during the duplicating attempts, or due to not following the procedures designed to duplicate concerns properly and in the sequence indicated.

Specific Conditions Can Affect the Condition

Consider the following conditions which may not have been present while attempts were made to duplicate the vibration concern. Attempt to obtain more specific information from the customer as to the EXACT conditions that are present when they experience the vibration which they are concerned about. Attempt to duplicate the vibration concern again while recreating the EXACT conditions necessary, except those which pose a safety concern or are outside the boundaries of normal operating conditions, such as loading the vehicle beyond its designed weight ratings, etc.

Most attempts to duplicate a vibration concern are made after the vehicle has been driven to the repair facility and perhaps even sat inside the building for a time; the vehicle may be too warm to detect the concern during duplication efforts. The opposite could also occur; perhaps the vehicle has sat out in the cold for a time and fails to reach full operating temperatures during attempts to duplicate the concern.

Temperature, Ground-Out, Accessory Load

Flat Spots on Tires

Tires which have sat and been cool for a time can develop flat spots.

Irregular Wear on Tire Treads

Tires which have sat and been cool for a time will be stiffer and any irregular wear conditions will be more noticeable than they will be once the tires have warmed and softened.

Exhaust System Growth

Exhaust systems may exhibit a ground-out condition when cool which goes away once the system is hot. The opposite may be true that the exhaust system is fine when cool but a ground-out condition occurs once the system reaches operating temperatures. Exhaust systems can grow by 2½–5 cm (1–2 in) when hot.

Engine-Driven Accessory Noises

Note: When a stethoscope equipped with a probe is used to assist in identifying possible vibrating components, the results must be compared to the sound quality of the same accessory, in a equally-equipped, same model year and type, KNOWN GOOD vehicle, and under the same conditions. Refer to *Vehicle-to-Vehicle Diagnostic Comparison on page 1-51*.

A stethoscope equipped with a probe can be used as an additional means to assist in identifying accessories which may be causing or contributing to a vibration concern.

- Belt Whipping

  An engine accessory drive belt, or belts could exhibit a whipping condition if a belt is deteriorating and deposits are building up on the underside of the belt.
- Loose Mounting Brackets or Component Ground-Out

  Engine-driven accessories such as a generator, a power steering pump, or an air conditioning compressor could exhibit noise conditions due to either loose mounting brackets or due to related components of the system in a ground-out condition during certain operation of that accessory system.
- Cold or Hot

  Accessories could exhibit noise conditions when cool which go away once they are fully warmed-up, or the opposite may be true.
- Load on an Accessory Component

  Accessories could exhibit a noise condition while under a heavy load – perhaps when combined with a cool or fully warmed-up condition.
- Bent or Misaligned Pulleys

  Bent or mis-aligned pulleys in one or more engine-driven accessory systems could contribute to a noise or vibration condition.
- Fluid Level in Accessory Systems

  Accessories could exhibit a noise condition due to an abnormal amount of fluid contained in the system of which the accessory is a part. For example:
  - An improper power steering fluid level could produce noises in the power steering system.
  - An improper air conditioning refrigerant level or an excessive amount of refrigerant oil could produce noises or possibly vibrations in the air conditioning system.
- Incorrect Fluid Type in Accessory Systems

  Accessories could exhibit a noise condition due to the incorrect type of fluid contained in the system of which the accessory is a part.

Vehicle Payload

The vibration concern may only occur when the vehicle is carrying heavy payloads or towing a trailer; the vehicle may have been empty during duplication efforts.

Heavy Payload

The vehicle may have been empty during attempts to duplicate the vibration concern, but the customer may actually experience the vibration concern while the vehicle is carrying a large payload.

Trailer Towing

The customer may experience the vibration concern only while towing a trailer.

Roadway Selection

The selection of roadways used to perform the vibration duplication procedures is likely to be in the near vicinity of the repair facility and may not provide a road surface that is similar enough to the surface on which the customer usually drives the vehicle.

The customer may only experience the vibration on a particular roadway. Perhaps the roadway is overly crowned or is very bumpy or rough.

Vibration Diagnostic Aids - Vibration Duplicated, Component Not Identified

Note: If you have not completed the Vibration Analysis tables as indicated and reviewed Vibration Diagnostic Aids, refer to *Vibration Diagnostic Aids on page 1-48* BEFORE proceeding.

Aftermarket Add-On Accessories

Aftermarket accessories which have been added to the vehicle can actually transmit and magnify INHERENT component rotational frequencies, if the accessories were not installed correctly.

An accessory should be installed in such a way that it is isolated from becoming a possible transfer path into the rest of the vehicle. For example, if a set of running boards has been installed improperly and they are sensitive to a particular frequency of a rotating component, the running boards could begin to respond to the frequency and actually create a disturbance once the amplitude of the frequency reaches a high enough point , probably at a higher vehicle speed.

If the same set of running boards were installed properly—isolated properly—the transfer path would be removed and the disturbance would no longer be present.

Vibration Diagnostic Aids - Vibration Duplicated, Difficult to Isolate/ Balance Component

Note: If you have not completed the Vibration Analysis tables as indicated and reviewed Vibration Diagnostic Aids, refer to *Vibration Diagnostic Aids on page 1-48* BEFORE proceeding.

If you have duplicated the vibration concern but have had difficulty in balancing a component or isolating a component, refer to the following information.

Most vibration concerns are corrected or eliminated through correcting excessive runout of a component, correcting balance of a component or isolating a component which has come into abnormal contact with another object/component.

Components which can generate a lot of energy and are experiencing excessive runout, imbalance or ground-out can produce a vibration with a strong enough amplitude that the vibration can transmit to components which are closely related. This type of a condition is usually related to and sensitive to torque-load. The most likely system that could exhibit this type of a condition is the driveline.

Vibration Diagnostic Aids - Vibration Duplicated, Appears to Be Potential Operating Characteristic

Note: If you have not completed the Vibration Analysis tables as indicated and reviewed Vibration Diagnostic Aids, refer to *Vibration Diagnostic Aids on page 1-48* BEFORE proceeding.

Check Service Bulletins

If BOTH of the following statements are TRUE, then check service bulletins for the condition identified. If the condition has already been identified and investigated prior to this vehicle, and has been determined to be something that is not truly an operating characteristic or that perhaps is not design-intent, there will likely be adjustments or corrections identified which will address the condition.

- You CAREFULLY followed the steps indicated through reviewing the Diagnostic Starting Point – Vibration Diagnosis and completing the Vibration Analysis tables identified and you have duplicated the vibration concern.
- You have come to the conclusion through comparison with a very equally-equipped, same model year and type, KNOWN GOOD vehicle that the customer's concern is a condition that appears to be a potential operating characteristic of the vehicle.

Symptoms - Vibration Diagnosis and Correction

Note: Perform the following steps in sequence BEFORE using these symptom tables.

1. Begin the diagnosis of a vibration concern by reviewing *Diagnostic Starting Point - Vehicle on page 6-90* to become familiar with the diagnostic process used to properly diagnose vibration concerns.
2. Perform the *Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer) on page 1-37* or *Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope) on page 1-39* table before using these symptom tables in order to duplicate and effectively diagnose the customer's concern.

Symptom Tables

Refer to a Vibration Analysis table as indicated in the following symptom tables, based on the most dominant characteristic of the customer's vibration concern, felt or heard, that is evident during the appropriate condition of the occurrence.

Vibration Symptoms that are Felt

Category	Description	Typical Frequency Range	Condition of Occurrence	Area of Focus
Shake	Can sometimes be seen or felt in the steering wheel, seat or console. Related terminology: shimmy, wobble, waddle, shudder, hop	5–20 Hz	Vehicle Speed Sensitive Still occurs during coast down in NEUTRAL	Go to *Vibration Analysis - Tire and Wheel on page 1-43*
			Vehicle Speed Sensitive Affected by torque/load and/or steering input	Go to *Vibration Analysis - Hub and/or Axle Input on page 1-46*
Roughness	Similar to the feeling of holding a jigsaw.	20–50 Hz	Vehicle Speed Sensitive Still occurs during coast down in NEUTRAL	Go to *Vibration Analysis - Tire and Wheel on page 1-43*
			Vehicle Speed Sensitive Affected by torque/load and/or steering input	Go to *Vibration Analysis - Hub and/or Axle Input on page 1-46*

Vibration Symptoms that are Felt (cont'd)

Category	Description	Typical Frequency Range	Condition of Occurrence	Area of Focus
Buzz	Similar to the feeling of holding an electric razor. May be felt in the hands through the steering wheel, in the feet through the floor, or in the seat of the pants.	50–100 Hz	Vehicle Speed Sensitive Affected by torque/load and/or steering input	Go to *Vibration Analysis - Hub and/or Axle Input on page 1-46*
Tingling	May produce a "pins and needles" sensation or may put hands or feet "to sleep". Highest vibration frequency range that can still be felt.	Greater than 100 Hz	Vehicle Speed Sensitive Affected by torque/load and/or steering input	Go to *Vibration Analysis - Hub and/or Axle Input on page 1-46*

Vibration Symptoms that are Heard

Category	Description	Typical Frequency Range	Condition of Occurrence	Area of Focus
Boom	Usually heard as an interior noise similar to the noise of a bowling ball rolling down an alley, deep thunder, or a bass drum. • Related terminology—droning, growling, moaning, roaring, rumbling, humming • May not be accompanied by a perceptible vibration or roughness	20–60 Hz	Vehicle Speed Sensitive Still occurs during coast down in NEUTRAL	Go to *Vibration Analysis - Tire and Wheel on page 1-43*
			Vehicle Speed Sensitive Affected by torque/load and/or steering input	Go to *Vibration Analysis - Hub and/or Axle Input on page 1-46*
Moan or Drone	Similar to the sound of a bumblebee or blowing air across the top of a bottle. • Related terminology—humming, buzzing, resonance • May be accompanied by a perceptible vibration such as a buzz	60–120 Hz	Vehicle Speed Sensitive Affected by torque/load and/or steering input	Go to *Vibration Analysis - Hub and/or Axle Input on page 1-46*
Howl	Similar to the sound of the wind howling.	120–300 Hz	Vehicle Speed Sensitive Affected by torque/load and/or steering input	Go to *Vibration Analysis - Hub and/or Axle Input on page 1-46*
Whine	Similar to the sound of mosquitoes, turbine engines, or vacuum cleaners.	300–500 Hz	Vehicle Speed Sensitive Affected by torque/load	Go to *Symptoms - Automatic Transmission on page 16-25*

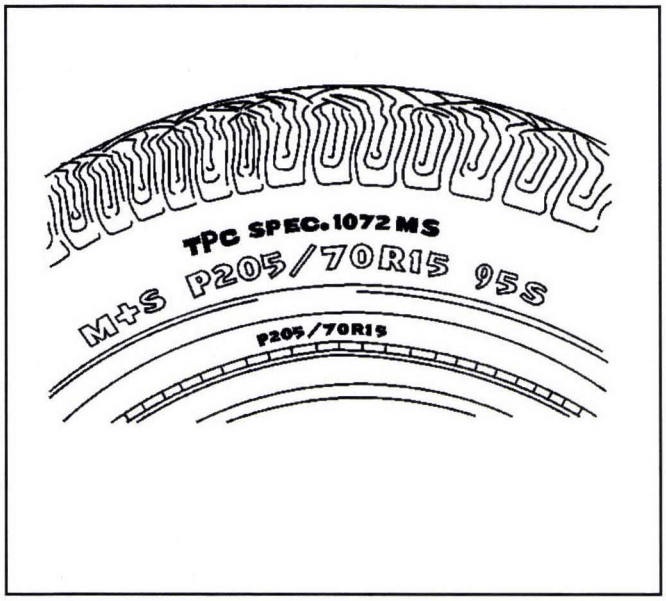
Vehicle-to-Vehicle Diagnostic Comparison

Comparing the customer's vehicle to a KNOWN GOOD vehicle that is essentially identical will help determine if the customer's concern may be characteristic of a vehicle design. To arrive at a valid conclusion, the comparison must be performed under the same conditions, using the same criteria, on a vehicle that has the same option content as the customer's vehicle.

The comparison vehicle must match the customer's vehicle in the following areas:

- Model Year
- Make
- Model
- Body style
- Powertrain configuration
- Driveline configuration
- Final drive ratio
- Tire/wheel size and type
- Suspension package
- Trailering package
- GVW rating
- Performance options
- Luxury options

Tire and Wheel Inspection



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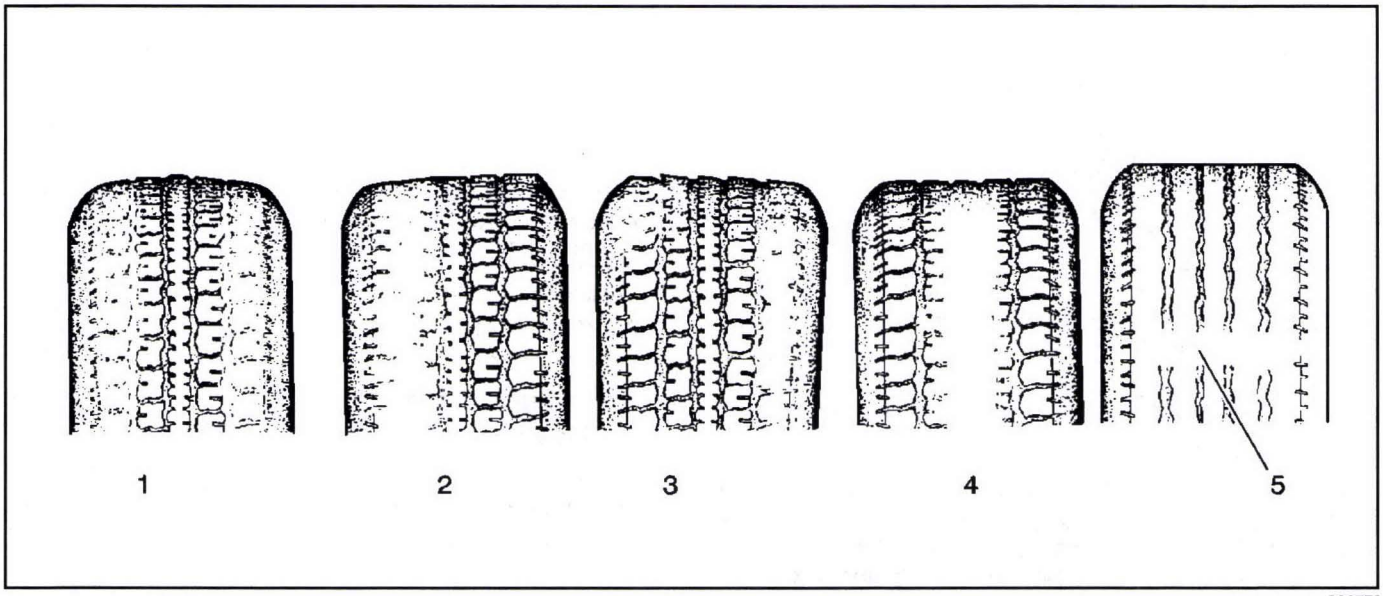
The tires on all new production models have a tire performance criteria (TPC) rating number molded on the sidewall. The TPC rating will appear as a 4-digit number preceded by the letters TPC SPEC on the tire wall near the tire size. A replacement tire should have the same TPC rating.

Tire Wear



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Legend

(1) Hard Cornering/Underinflation
(2) Incorrect Alignment/Lack of Rotation
(3) Incorrect Alignment/Non-uniform Tire
(4) Heavy Acceleration/Over inflation
(5) Wear Indicator

Inspect the tire and wheel assemblies for the following conditions:

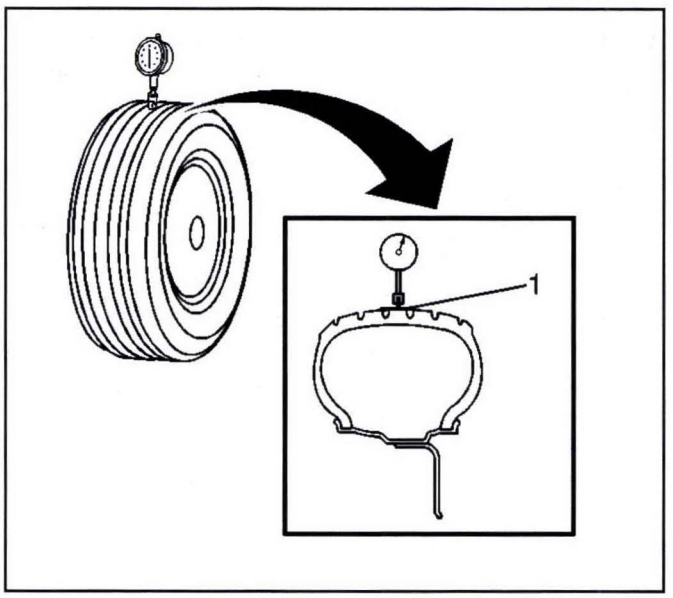
- Unusual wear such as cupping, flat spots, and/or heel-and-toe wear

  These conditions can cause tire growl, tire howl, slapping noises, and/or vibrations throughout the vehicle.
- Proper inflation to specifications for the vehicle
- Bulges in the sidewalls

  Do not confuse bulges, which are an abnormal condition, with normal ply splices which are commonly seen as indentations in the sidewall.
- Bent rim flanges

Tire and Wheel Assembly Runout Measurement - On-Vehicle

1. Raise and support the vehicle.
2. Closely inspect each tire for proper and even bead seating.
3. If any of the tire beads were not properly or evenly seated, reseat the tire bead, then proceed to step 4. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
4. Following the tire inflation placard on the drivers door, inspect and if necessary adjust the tire inflation pressures.



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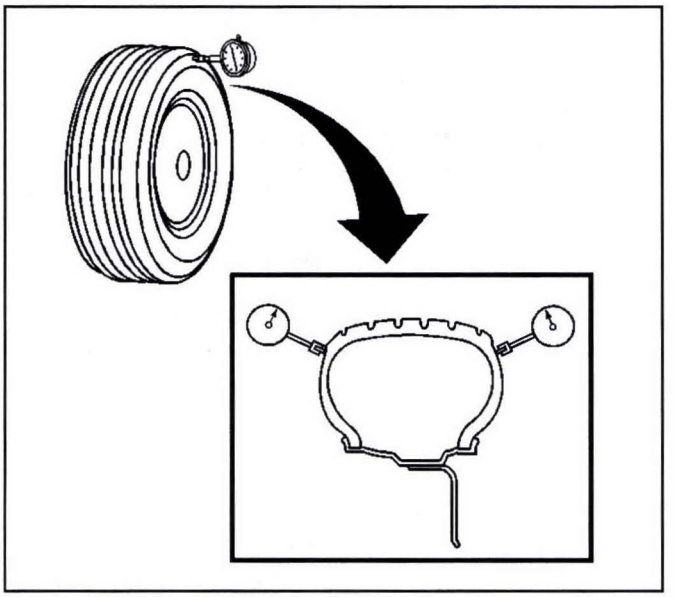
5. Wrap the circumference of each tire with tape (1) in the center tread area.

   Wrapping the tread with tape allows for a smooth and accurate reading of radial runout to be obtained.
6. Position the dial indicator on the taped portion of the tire tread such that the dial indicator is perpendicular to the tire tread surface.
7. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot.
8. Set the dial indicator to zero at the low spot.
9. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of radial runout.

   Specification

   Maximum tire and wheel assembly radial runout – measured on-vehicle: 1.52 mm (0.060 in)



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10. Position the dial indicator on a smooth portion of the tire sidewall, as close to the tread as possible, such that the dial indicator is perpendicular to the tire sidewall surface.
11. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot. Ignore any jumps or dips due to sidewall splices.
12. Set the dial indicator to zero at the low spot.
13. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of lateral runout. Ignore any jumps or dips due to sidewall splices and attain an average runout measurement.

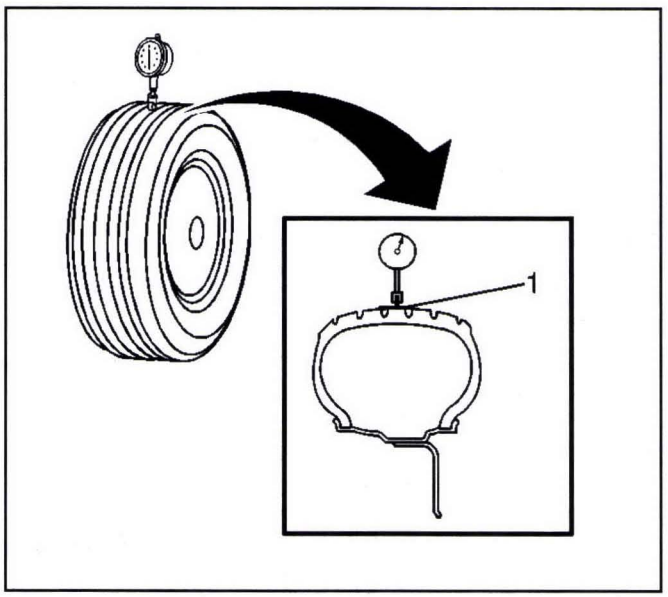
    Specification

    Maximum tire and wheel assembly lateral runout – measured on-vehicle: 1.52 mm (0.060 in)
14. Repeat steps 4 through 12 until all of the tire and wheel assembly radial and lateral runout measurements have been taken.
15. Lower the vehicle.

Tire and Wheel Assembly Runout Measurement - Off Vehicle

1. Raise and support the vehicle.
2. Mark the location of the wheels to the wheel studs and mark the specific vehicle position on each tire and wheel – LF, LR, RF, RR.
3. Remove the tire and wheel assemblies from the vehicle.
4. Closely inspect each tire for proper and even bead seating.
5. If any of the tire beads were not properly or evenly seated, reseat the tire bead, then proceed to step 6. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
6. Mount a tire and wheel assembly on a spin-type wheel balancer.

   Locate the tire and wheel assembly on the balancer with a cone through the back side of the center pilot hole.



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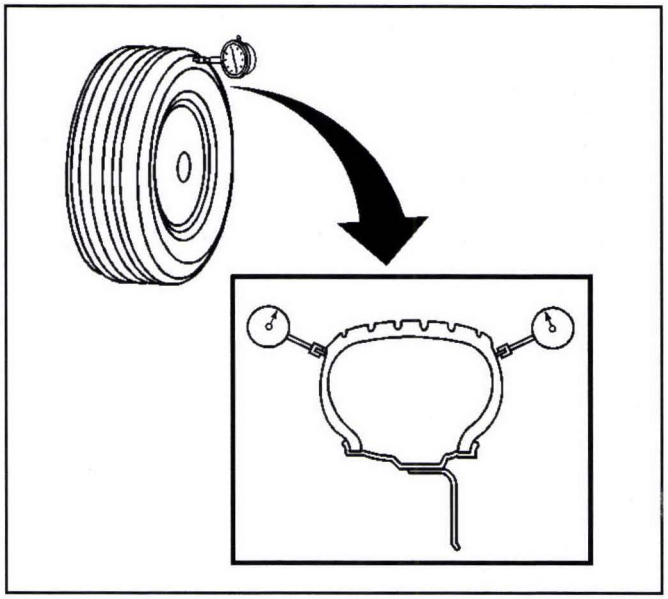
7. Wrap the outer circumference of each tire with tape (1) in the center tread area.

   Wrapping the tread with tape allows for a smooth and accurate reading of radial runout to be obtained.
8. Position the dial indicator on the taped portion of the tire tread such that the dial indicator is perpendicular to the tire tread surface.
9. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot.
10. Set the dial indicator to zero at the low spot.
11. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of radial runout.

    Specification

    Maximum tire and wheel assembly radial runout – measured off-vehicle: 1.27 mm (0.050 in)



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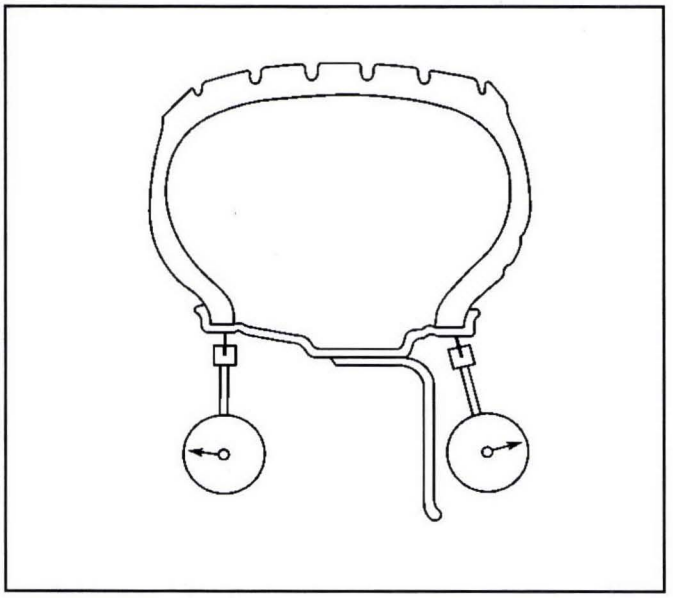
12. Position the dial indicator on a smooth portion of the tire sidewall, as close to the tread as possible, such that the dial indicator is perpendicular to the tire sidewall surface.
13. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot. Ignore any jumps or dips due to sidewall splices.
14. Set the dial indicator to zero at the low spot.
15. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of lateral runout. Ignore any jumps or dips due to sidewall splices and attain an average runout measurement.

    Specification

    Maximum tire and wheel assembly lateral runout – measured off-vehicle: 1.27 mm (0.050 in)
16. Repeat steps 6 through 15 until all of the tire and wheel assembly radial and lateral runout measurements have been taken.
17. If ANY of the tire and wheel assembly runout measurements were NOT within specifications, proceed to step 19.
18. If ALL of the tire and wheel assembly runout measurements WERE within specifications, then the off-vehicle tire and wheel assembly runout is considered acceptable.



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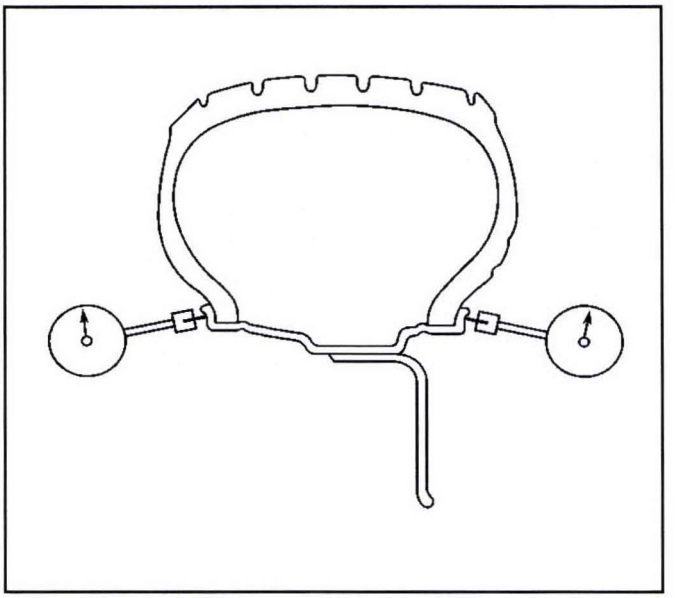

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19. Position the dial indicator on the horizontal outer surface of the wheel rim flange – with the tire still mounted – such that the dial indicator is perpendicular to the rim flange surface.

    Wheel runout should be measured on both the inboard and outboard rim flanges, unless wheel design will not permit. Ignore any jumps or dips due to paint drips, chips, or welds.
20. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot.
21. Set the dial indicator to zero at the low spot.
22. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of wheel radial runout.

    Specification

    - Maximum aluminum wheel radial runout – measured off-vehicle, tire mounted: 0.762 mm (0.030 in)
    - Maximum steel wheel radial runout – measured off-vehicle, tire mounted: 1.015 mm (0.040 in)
23. Position the dial indicator on the vertical outer surface of the wheel rim flange – with the tire still mounted – such that the dial indicator is perpendicular to the rim flange surface.

    Wheel runout should be measured on both the inboard and outboard rim flanges, unless wheel design will not permit. Ignore any jumps or dips due to paint drips, chips, or welds.
24. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot.
25. Set the dial indicator to zero at the low spot.
26. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of wheel lateral runout.

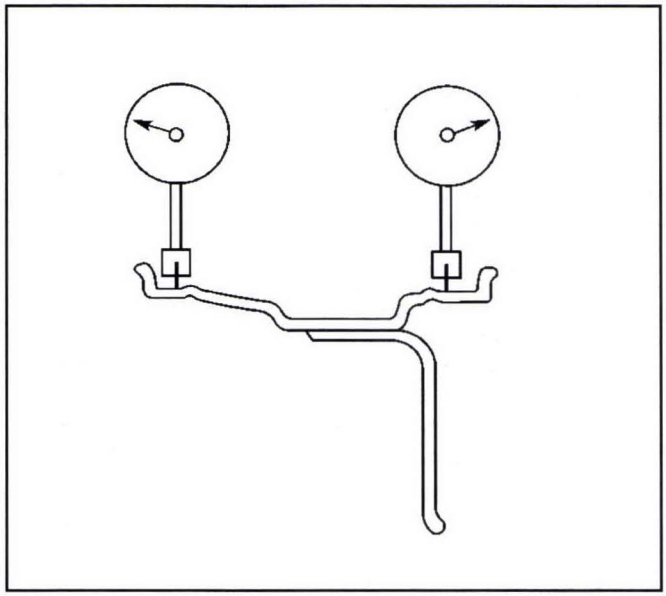
    Specification

    - Maximum aluminum wheel lateral runout – measured off-vehicle, tire mounted: 0.762 mm (0.030 in)
    - Maximum steel wheel lateral runout – measured off-vehicle, tire mounted: 1.143 mm (0.045 in)
27. Repeat steps 19 through 26 until all of the wheel radial and lateral runout measurements have been taken on each of the – tire and wheel – assemblies with assembly runout measurements which were NOT within specifications.
28. If any of the wheel runout measurements were NOT within specifications, proceed to Measuring Wheel Runout – Tire Dismounted.
29. For any of the wheel runout measurements which WERE within specifications, while the – tire and wheel – assembly runout measurements were NOT within specifications, replace the tire, then balance the assembly. Refer to *Tire and Wheel Assembly Balancing - Off Vehicle on page 1-59*.
30. After replacement of any tires, always re-measure the runout of the affected tire and wheel assembly, or assemblies.

31. Using the matchmarks made prior to removal, install the tire and wheel assemblies to the vehicle.
32. Lower the vehicle.

Wheel Runout Measurement – Tire Dismounted

1. On the tire and wheel assembly, or assemblies with wheel runout measurements – tire mounted – which were NOT within specifications, mark each tire and wheel in relation to each other.
2. Dismount the tire from the wheel.
3. Mount the wheel on a spin-type wheel balancer.
4. Locate the wheel on the balancer with a cone through the back side of the center pilot hole.



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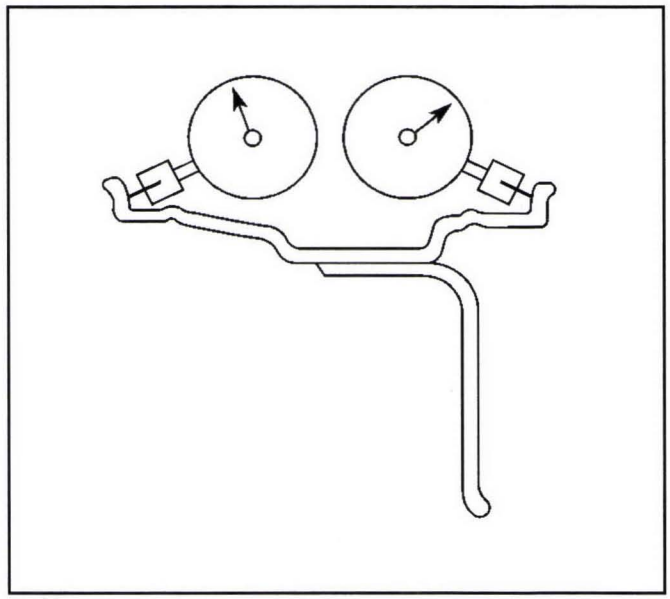
5. Position the dial indicator on the horizontal inner surface of the wheel rim flange – with the tire dismounted – such that the dial indicator is perpendicular to the rim flange surface.

   Wheel runout should be measured on both the inboard and outboard rim flanges. Ignore any jumps or dips due to paint drips, chips, or welds.
6. Slowly rotate the wheel one complete revolution in order to find the low spot.
7. Set the dial indicator to zero at the low spot.
8. Slowly rotate the wheel one more complete revolution and measure the total amount of wheel radial runout.

   Specification

   - Maximum aluminum wheel radial runout – measured off-vehicle, tire dismounted: 0.762 mm (0.030 in)
   - Maximum steel wheel radial runout – measured off-vehicle, tire dismounted: 1.015 mm (0.040 in)



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9. Position the dial indicator on the vertical inner surface of the wheel rim flange – with the tire dismounted – such that the dial indicator is perpendicular to the rim flange surface.

   Wheel runout should be measured on both the inboard and outboard rim flanges. Ignore any jumps or dips due to paint drips, chips, or welds.
10. Slowly rotate the wheel one complete revolution in order to find the low spot.
11. Set the dial indicator to zero at the low spot.
12. Slowly rotate the wheel one more complete revolution and measure the total amount of wheel lateral runout.

    Specification

    - Maximum aluminum wheel lateral runout – measured off-vehicle, tire dismounted: 0.762 mm (0.030 in)
    - Maximum steel wheel lateral runout – measured off-vehicle, tire dismounted: 1.143 mm (0.045 in)
13. Repeat steps 2 through 12 until all of the wheel radial and lateral runout measurements – tire dismounted – have been taken on each wheel with runout measurements – tire mounted – which were NOT within specifications.
14. If any of the wheel runout measurements – tire dismounted – were NOT within specifications, replace the wheel.

    Always measure the runout of any replacement wheels.
15. For any of the wheel runout measurements which WERE within specifications, while the – tire and wheel – assembly runout measurements were NOT within specifications, replace the tire, then balance the assembly. Refer to *Tire and Wheel Assembly Balancing - Off Vehicle on page 1-59*.
16. Using the matchmarks made prior to dismounting the tire, or tires, mount the tire, or tires to the wheel, or wheels, then balance the assembly, or assemblies. Refer to *Tire and Wheel Assembly Balancing - Off Vehicle on page 1-59*.

Always measure the runout of any of the tire and wheel assemblies which have had the tires dismounted and mounted.

17. Using the matchmarks made prior to removal, install the tire and wheel assemblies to the vehicle.
18. Lower the vehicle.

Brake Rotor/Drum Balance Inspection

Danger: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

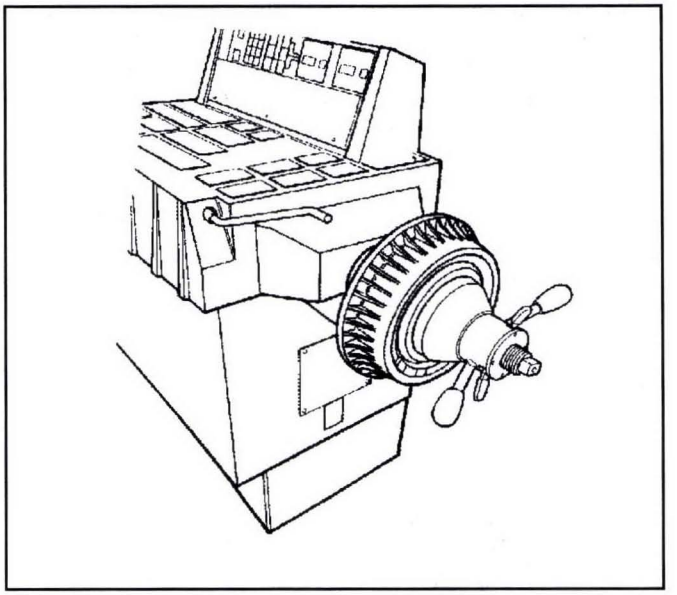
1. Support the vehicle drive axle on a suitable hoist. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
2. Remove the tire and wheel assemblies from the drive axle. Refer to *Tire and Wheel Removal and Installation on page 15-51*.

Warning: Refer to Work Stall Test Warning on page 0-7.

3. Reinstall the wheel nuts in order to retain the brake rotors.
4. Run the vehicle at the concern speed while inspecting for the presence of the vibration.

Caution: Do not depress the brake pedal with the brake rotors and/or the brake drums removed, or with the brake calipers repositioned away from the brake rotors, or damage to the brake system may result.

5. If the vibration is still present, remove the rotors from the drive axle, then run the vehicle back to the concern speed.
6. If the vibration is eliminated when the brake rotors are removed from the drive axle, repeat the test with one rotor installed at a time. Replace the rotor that is causing or contributing to the vibration concern.



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7. If a brake rotor was replaced as a result of following the previous steps, or if necessary to confirm the results obtained during the previous steps, and/or to check the non-drive axle components, perform the following:
   7.1. Mount the brake rotor/drum on a balancer in the same manner as a tire and wheel assembly.

   Note: Check brake rotors/drums for static imbalance only; ignore the dynamic imbalance readings.

   7.2. Inspect the rotor/drum for static imbalance.

There is not a set tolerance for brake rotor/drum static imbalance. However, any brake rotor/drum measured in this same manner which is over 21 g (¾ oz) may have the potential to cause or contribute to a vibration. Rotors/drums suspected of causing or contributing to a vibration should be replaced. Any rotor/drum that is replaced should be checked for imbalance in the same manner.

Hub/Axle Flange and Wheel Stud Runout Inspection

Danger: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

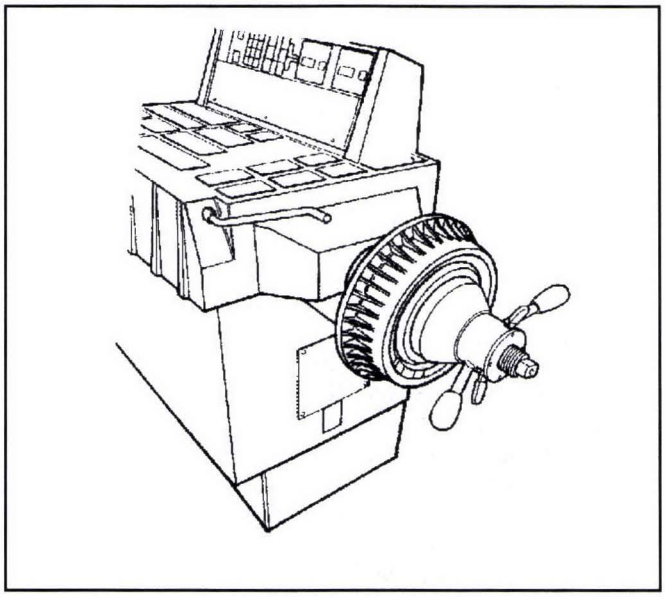
1. Support the vehicle drive axle on a suitable hoist. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
2. Remove the tire and wheel assemblies from the drive axle. Refer to *Tire and Wheel Removal and Installation on page 15-51*.

Warning: Refer to Work Stall Test Warning on page 0-7.

3. Reinstall the wheel nuts in order to retain the brake rotors.
4. Run the vehicle at the concern speed while inspecting for the presence of the vibration.

Caution: Do not depress the brake pedal with the brake rotors and/or the brake drums removed, or with the brake calipers repositioned away from the brake rotors, or damage to the brake system may result.

5. If the vibration is still present, remove the rotors from the drive axle, then run the vehicle back to the concern speed.
6. If the vibration is eliminated when the brake rotors are removed from the drive axle, repeat the test with one rotor installed at a time. Replace the rotor that is causing or contributing to the vibration concern.



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7. If a brake rotor was replaced as a result of following the previous steps, or if necessary to confirm the results obtained during the previous steps, and/or to check the non-drive axle components, perform the following:
   7.1. Mount the brake rotor/drum on a balancer in the same manner as a tire and wheel assembly.

   Note: Check brake rotors/drums for static imbalance only; ignore the dynamic imbalance readings.

   7.2. Inspect the rotor/drum for static imbalance.

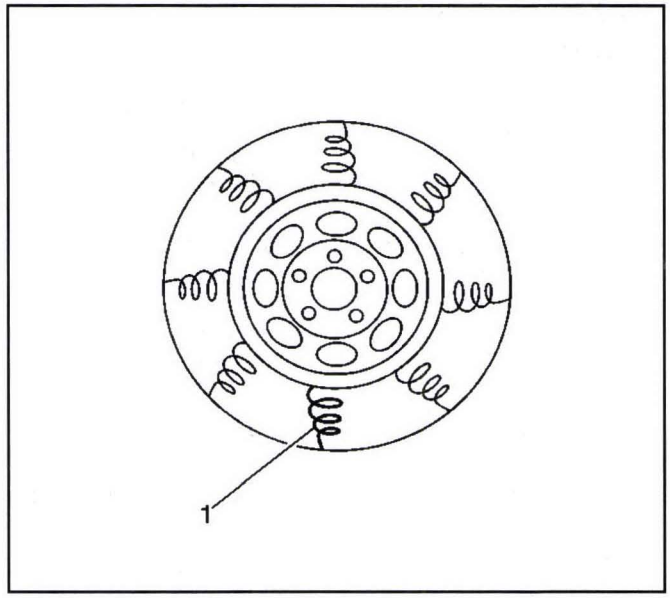
There is not a set tolerance for brake rotor/drum static imbalance. However, any brake rotor/drum measured in this same manner which is over 21 g (¾ oz) may have the potential to cause or contribute to a vibration. Rotors/drums suspected of causing or contributing to a vibration should be replaced. Any rotor/drum that is replaced should be checked for imbalance in the same manner.

Tire and Wheel Assembly Isolation Test

Force Variation

Force variation refers to a radial or lateral movement of the tire and wheel assembly which acts much like runout, however, force variation has to do with variations in the construction of the tire. These variations in tire construction may actually cause vibration in a vehicle, even though the tire and wheel assembly runout and balance may be within specifications.

Radial Force Variation



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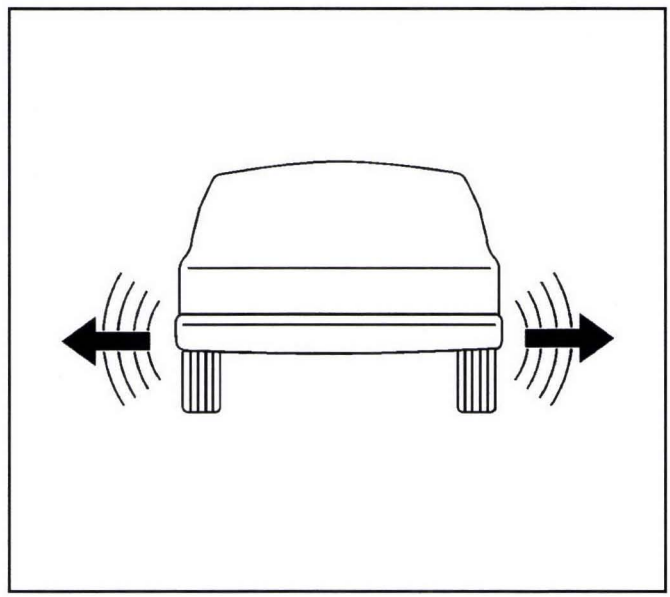
Radial force variation refers to the difference in the stiffness of a tire sidewall as the tire rotates and contacts the road. Tire sidewalls have some stiffness due to splices in the different plies of the tire, but these stiffness differences do not cause a problem unless the force variation is excessive. Stiff spots (1) in a tire sidewall can deflect a tire and wheel assembly upward as the assembly contacts the road.

Lateral Force Variation



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Lateral force variation refers to the difference in the stiffness or conformity of the belts within a tire as the tire rotates and contacts the road. Tire belts may have some stiffness or conformity differences, but these differences do not cause a problem unless the force variation is excessive. These variations in the belts of the tire can deflect the vehicle sideways or laterally. A shifted belt inside a tire may cause lateral force variation.

In most cases where excessive lateral force variation exists, the vehicle will display a wobble or waddle at low speeds, 8–40 km/h (5–25 mph), on a smooth road surface.

Isolation Test Procedure

Perform the following test in order to determine if force variation is present in the vehicle.

1. Substitute a set of KNOWN GOOD, pre-tested tire and wheel assemblies of the same size and type for the suspected original assemblies. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
2. Road test the vehicle to determine if the vibration is still present. Refer to *Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer) on page 1-37* or *Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope) on page 1-39*.
3. If the vibration is still present while using the known good set of tire and wheel assemblies, then force variation is not the cause of the vibration.
4. If the vibration is eliminated when using the known good set of tire and wheel assemblies, install one of the original tire and wheel assemblies using the matchmarks made prior to removal. Refer to *Tire and Wheel Removal and Installation on page 15-51*. Road test the vehicle to determine if the vibration has returned. Refer to *Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer) on page 1-37* or *Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope) on page 1-39*.
5. Continue the process of installing the original tire and wheel assemblies one at a time, then road testing the vehicle, until the tire and wheel assembly, or assemblies which is causing the vibration has been identified.
6. Replace the tire, or tires on the vibration-causing tire and wheel assembly, or assemblies, then balance the assembly, or assemblies. Refer to *Tire and Wheel Assembly Balancing - Off Vehicle on page 1-59*.

Repair Instructions

Tire and Wheel Assembly Balancing - Off Vehicle

Warning: Failure to adhere to the following precautions before tire balancing can result in personal injury or damage to components:

- ***Clean away any dirt or deposits from the inside of the wheels.***
- ***Remove any stones from the tread.***
- ***Wear eye protection.***
- ***Use coated weights on aluminum wheels.***

Tire and Wheel Assembly Balancer Calibration

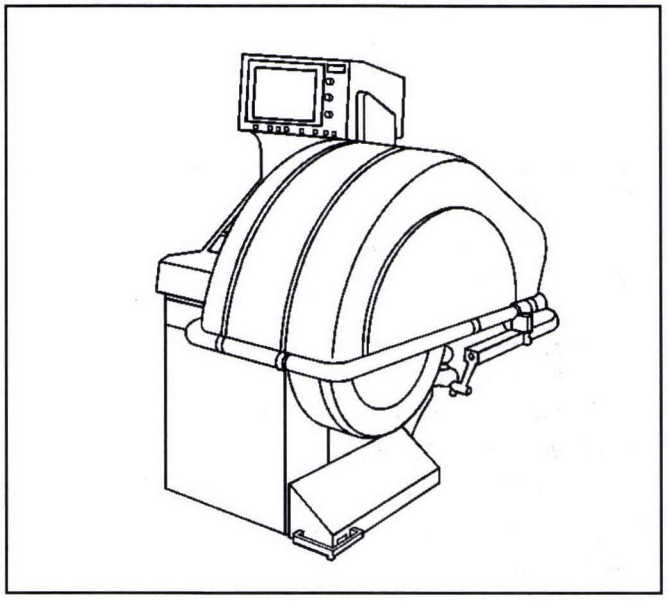
Tire and wheel balancers can drift out of calibration over time, or can become inaccurate as a result of heavy use. There will likely not be any visual evidence that a calibration problem exists. If a balancer is not calibrated within specifications, and a tire and wheel assembly is balanced on that machine, the assembly may actually be imbalanced.

Tire and wheel assembly balancer calibration should be checked approximately every 2 weeks, if the machine is used frequently, and/or whenever the balance readings are questionable.

Tire and Wheel Assembly Balancer Calibration Test

Note: If the balancer fails any of the steps in this calibration test, the balancer should be calibrated according to the manufacturer's instructions. If the balancer cannot be calibrated, contact the manufacturer for assistance.

Inspect the calibration of the tire and wheel assembly balancer according to the manufacturer's recommendations, or perform the following test.



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1. Spin the balancer without a wheel or any of the adapters on the shaft.
2. Inspect the balancer readings.

   Specification

   Zero within 7 g (¼ oz)
3. If the balancer is within the specification range, balance a tire and wheel assembly – that is within radial and lateral runout tolerances – to ZERO, using the same balancer.
4. After the tire and wheel assembly has been balanced, add an 85 g (3 oz) test weight to the wheel at any location.
5. Spin the tire and wheel assembly again. Note the readings.
   - In the static and dynamic modes, the balancer should call for 85 g (3 oz) of weight, 180 degrees opposite the test weight.
   - In the dynamic mode, the weight should be called for on the flange of the wheel opposite the test weight.
6. With the assembly imbalanced to 85 g (3 oz), cycle the balancer 5 times.
7. Inspect the balancer readings:

   Specification

   Maximum variation: 7 g (¼ oz)
8. Index the tire and wheel assembly on the balancer shaft, 90 degrees from the previous location.
9. Cycle the balancer with the assembly at the new location.
10. Inspect the balancer readings:

    Specification

    Maximum variation: 7 g (¼ oz)
11. Repeat steps 8 through 10 until the tire and wheel assembly has been cycled and checked at each of the 4 locations on the balancer shaft.

Tire and Wheel Assembly Balancing Guidelines

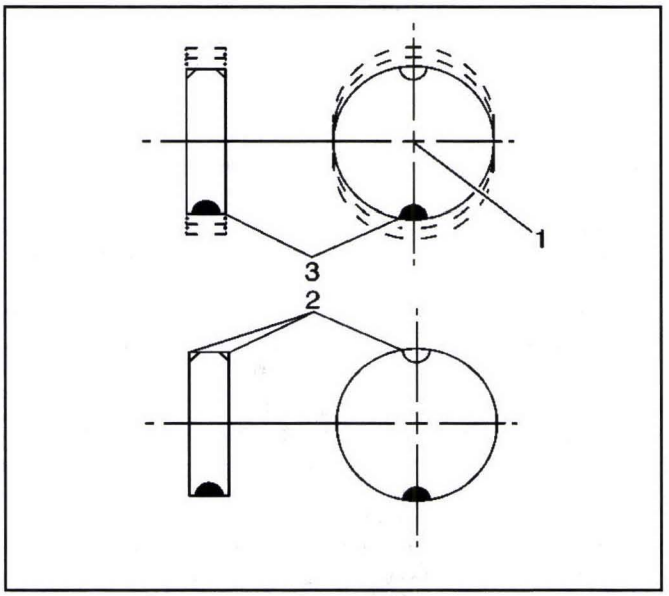
Note: Tire and wheel assemblies which exhibit excessive runout can produce vibrations even if the assemblies are balanced.

It is strongly recommended that the tire and wheel assembly runout be measured and corrected if necessary BEFORE the assemblies are balanced.

If the runout of the tire and wheel assemblies has not yet been measured, refer to *Tire and Wheel Assembly Runout Measurement - Off Vehicle on page 1-54* before proceeding.

There are 2 types of tire and wheel balance:

Static Balance



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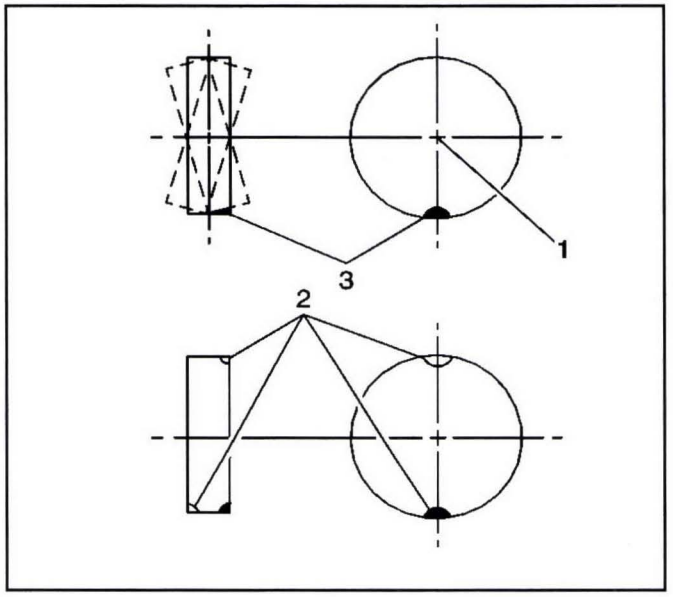
Static balance is the equal distribution of weight around the wheel circumference. The wheel balance weights (2) are positioned on the wheel in order to offset the effects of a heavy spot (3). Wheels that have static imbalance can produce a bouncing action called tramp.

Dynamic Balance



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Dynamic balance is the equal distribution of weight on each side of the tire and wheel assembly centerline. The wheel balance weights (2) are positioned on the wheel in order to offset the effects of a heavy spot (3). Wheels that have dynamic imbalance have a tendency to move from side to side and can cause an action called shimmy.

Most off-vehicle balancers are capable of checking both types of balance simultaneously.

As a general rule, most vehicles are more sensitive to static imbalance than to dynamic imbalance; however, vehicles equipped with low profile, wide tread path, high performance tires and wheels are susceptible to small amounts of dynamic imbalance. As little as 14–21 g (½–¾ oz) imbalance is capable of inducing a vibration in some vehicle models.

Balancing Procedure

Note: When balancing tire and wheel assemblies, use a known good, recently calibrated, off-vehicle, two-plane dynamic balancer set to the finest balance mode available.

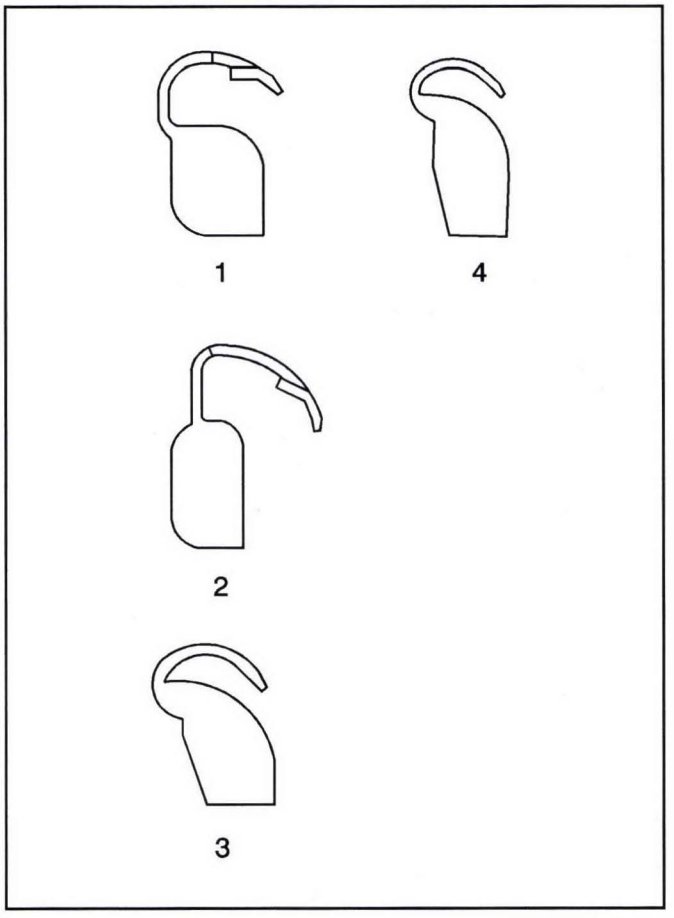
Danger: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
2. Mark the location of the wheels to the wheel studs and mark the specific vehicle position on each tire and wheel – LF, LR, RF, RR.
3. Remove the tire and wheel assemblies one at a time and mount on a spin-type wheel balancer. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
4. Carefully follow the wheel balancer manufacturer's instructions for proper mounting techniques to be used on different types of wheels. Regard aftermarket wheels, especially those incorporating universal lug patterns, as potential sources of runout and mounting concerns.
5. Be sure to use the correct type of wheel balance weights for the type of wheel rim being balanced. Be sure to use the correct type of coated wheel balance weights on aluminum wheels. Refer to Wheel Weight Usage.
6. Balance all four tire and wheel assemblies as close to zero as possible.
7. Using the matchmarks made prior to removal, install the tire and wheel assemblies to the vehicle. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
8. Lower the vehicle.

Wheel Weight Usage

Tire and wheel assemblies can be balanced using either the static or dynamic method.

Clip-on Weights



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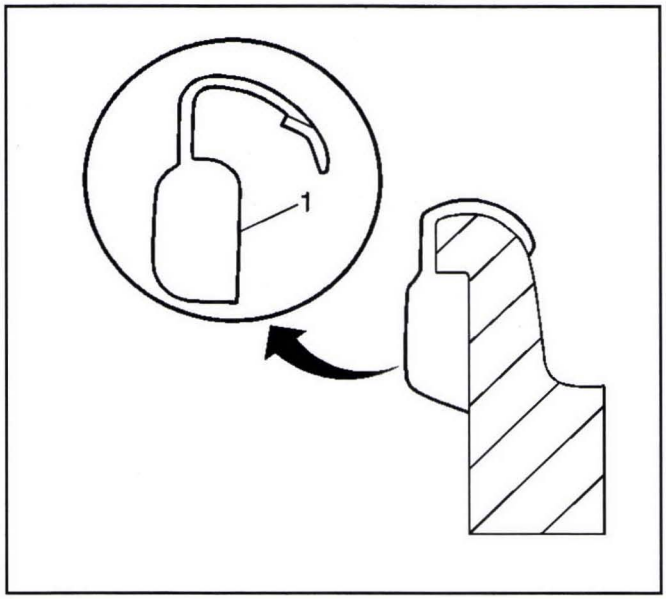
Note: When balancing factory aluminum wheels with clip-on wheel balance weights, be sure to use special polyester-coated weights. These coated weights reduce the potential for corrosion and damage to aluminum wheels.

These coated weights reduce the potential for corrosion and damage to aluminum wheels.

- MC (1) and AW (2) series weights are approved for use on aluminum wheels.

- P (3) series weights are approved for use on steel wheels only.
- T (4) series coated weights are approved for use on both steel and aluminum wheels.



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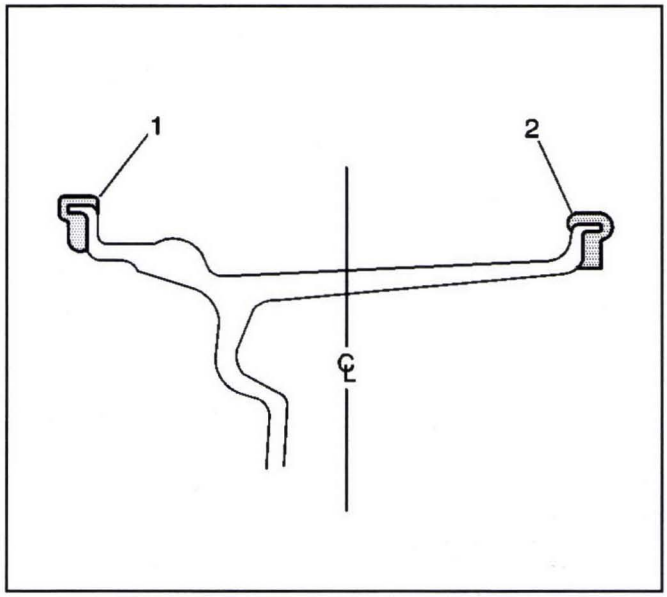
Note: Use a nylon or plastic-tipped hammer when installing coated clip-on wheel balance weights to minimize the possibility of damage to the polyester coating.

The contour and style of the wheel rim flange will determine which type of clip-on wheel weight (1) should be used. The weight should follow the contour of the rim flange. The weight clip should firmly grip the rim flange.

Wheel Weight Placement – Clip-on Weights



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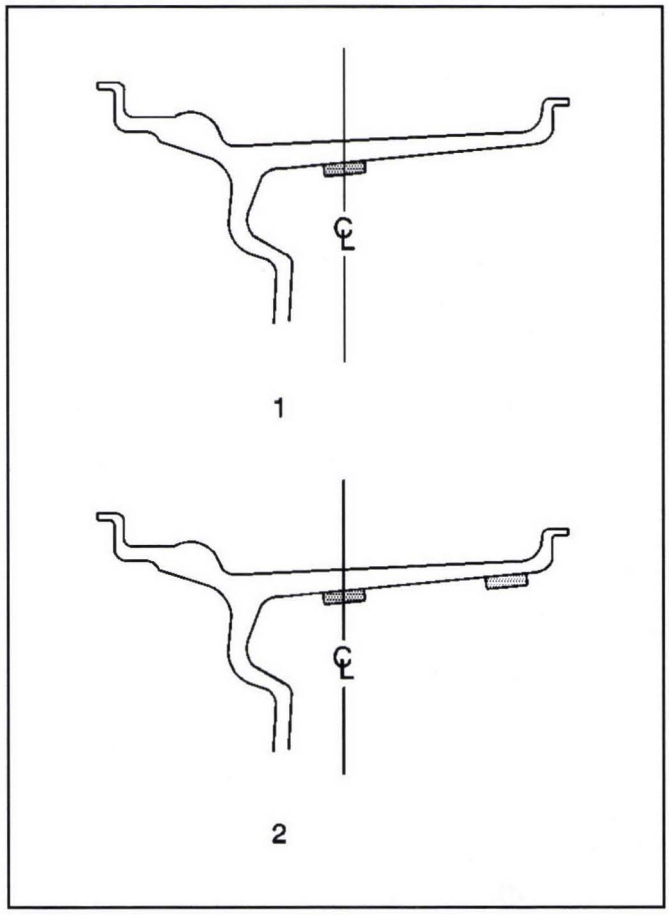
When static balancing, locate the wheel balance weights on the inboard flange (2) if only 28 g (1 oz) or less is called for. If more than 28 g (1 oz) is called for, split the weights as equally as possible between the inboard (2) and outboard (1) flanges.

When dynamic balancing, locate the wheel balance weights on the inboard (2) and outboard (1) rim flanges at the positions specified by the wheel balancer.

Adhesive Weights



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Note: When installing adhesive balance weights on flangeless wheels, do NOT install the weight on the outboard surface of the rim.

Adhesive wheel balance weights may be used on factory aluminum wheels. Perform the following procedure to install adhesive wheel balance weights.

1. Determine the correct areas for placement of the wheel weights on the wheel.
   - When static balancing, locate the wheel balance weights along the wheel centerline (1) on the inner wheel surface if only 28 g (1 oz) or less is called for. If more than 28 g (1 oz) is called for, split the weights as equally as possible between the wheel centerline and the inboard edge of the inner wheel surface (2).
   - When dynamic balancing, locate the wheel balance weights along the wheel centerline and the inboard edge of the inner wheel surface (2) at the positions specified by the wheel balancer.
2. Ensure that there is sufficient clearance between the wheel weights and brake system components.

Note: Do not use abrasives to clean any surface of the wheel.

3. Using a clean cloth or paper towel with a general purpose cleaner, thoroughly clean the designated balance weight attachment areas of any corrosion, overspray, dirt or any other foreign material.
4. To ensure there is no remaining residue, wipe the balance weight attachment areas again, using a clean cloth or paper towel with a mixture of half isopropyl alcohol and half water.
5. Dry the attachment areas with hot air until the wheel surface is warm to the touch.
6. Warm the adhesive backing on the wheel balance weights to room temperature.
7. Remove the protective covering from the adhesive backing on the back of the balance weights. DO NOT touch the adhesive surface.
8. Apply the wheel balance weights to the wheel, press into place with hand pressure.
9. Secure the wheel balance weights to the wheel with a 90 N (21 lb) force applied with a roller.

Tire and Wheel Assembly Balancing - On-Vehicle

Special Tools

EL-38792-A Electronic Vibration Analyzer (EVA) 2

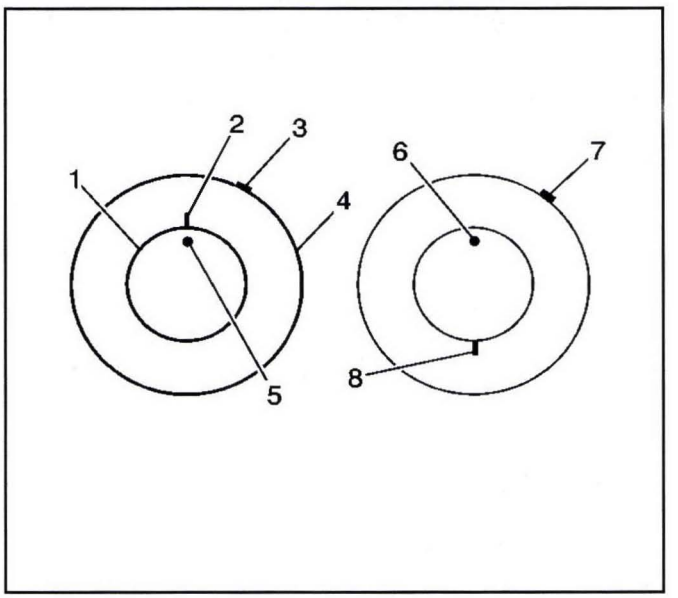
If after following the tire and wheel vibration diagnostic process, some amount of tire and wheel vibration is still evident, an on-vehicle high-speed spin balancer may be used to perform an on-vehicle balance in an attempt to finish balance the tire and wheel assemblies, wheel hubs, brake rotors, brake drums, if equipped, and wheel trim, if equipped, simultaneously. On-vehicle balancing can also compensate for minor amounts of residual runout encountered as a result of mounting the tire and wheel assembly on the vehicle, as opposed to the balance which was achieved on the off-vehicle balancer.

In order to perform an on-vehicle balancing procedure, carefully follow the on-vehicle balancer manufacturer's specific operating instructions and carefully consider the following information before proceeding:

- Vehicles equipped with low profile, wide tread path, high performance tires and wheels are susceptible to small amounts of dynamic imbalance.
- When performing an on-vehicle balance, great care must be taken when placing the wheel balance weights on the wheels. If the wheel balance weights are not placed accurately, they can actually induce dynamic imbalance and thus increase the severity of the vibration.
- Inspect the vehicle wheel bearings to ensure that they are in good condition.
- Thoroughly inspect all on-vehicle balancing equipment and ensure that it is fully within the manufacturer's recommended specifications.
- Do not remove the off-vehicle balance weights. The purpose of on-vehicle balance is to fine tune the assembly balance already achieved off-vehicle, not to start over.
- Leave all wheel trim installed whenever possible.
- If the on-vehicle balancer calls for more than 56 g (2 oz) of additional weight, split the weight between the inboard and outboard flanges of the wheel, so as not to upset the dynamic balance of the assembly achieved in the off-vehicle balance. For wheel balance weight information, refer to *Tire and Wheel Assembly Balancing - Off Vehicle on page 1-59*.
- If available, tape-off an area on top of the fenders and the quarter panels, then place the vibration sensor of the *EL-38792-A* Electronic Vibration Analyzer (EVA) 2 on the fender or quarter panel above the specific tire and wheel assembly while it is being on-vehicle balanced.

  The *EL-38792-A* Electronic Vibration Analyzer (EVA) 2 will provide a visual indication of the amplitude of the vibration, and the effect that the on-vehicle balance has on it.

Tire-to-Wheel Match-Mounting (Vectoring)



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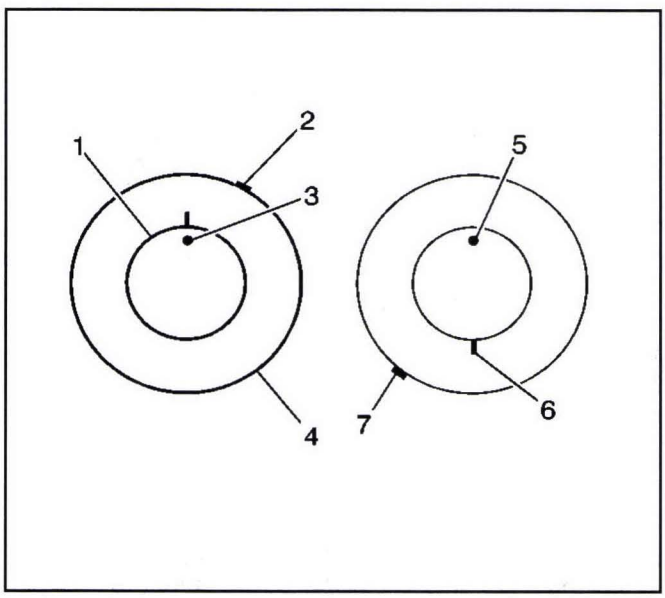
Note: After remounting a tire to a wheel or after replacing a tire and/or a wheel, remeasure the tire and wheel assembly runout in order to verify that the amount of runout has been reduced and brought to within tolerances. Ensure that the tire and wheel assembly is properly balanced before reinstalling to the vehicle.

1. Mark the location of the high spot (3) on the tire as determined during the off-vehicle tire and wheel assembly runout measurement.
2. Place a reference mark (2) on the tire sidewall at the location of the valve stem (5).
   - Always refer to the valve stem as the 12 o'clock position.
   - Refer to the location of the high spot (3) by its clock position on the wheel, relative to the valve stem.

3. Mount the tire and wheel assembly on a tire machine and break down the bead. Do not dismount the tire from the wheel at this time.
4. Rotate the tire 180 degrees on the rim so that the valve stem reference mark (8) is now at the 6 o'clock position in relation to the valve stem (6). You may need to lubricate the bead in order to easily rotate the tire on the wheel.
5. Reinflate the tire and seat the bead properly.
6. Mount the assembly on the tire balancer and remeasure the runout. Mark the new location of the assembly runout high spot on the tire.
7. If the assembly runout has been reduced and is within tolerance, no further steps are necessary. Balance the tire and wheel assembly, then install the assembly to the vehicle. Refer to the following:
   - *Tire and Wheel Assembly Balancing - Off Vehicle on page 1-59*
   - *Tire and Wheel Removal and Installation on page 15-51*
8. If the clock location of the high spot remained at or near the original clock location of the high spot (7) and the assembly runout has NOT been reduced, the wheel is the major contributor to the assembly runout concern.



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9. If the clock location of the high spot has moved, however the assembly runout has NOT been reduced, perform the following steps:
   9.1. If the clock location of the high spot (7) is now at or near a position 180 degrees from the original clock location of the high spot, the tire is the major contributor to the assembly runout concern.
   9.2. If the clock location of the high spot is now in-between the 2 extremes, then both the tire and the wheel are both contributing to the assembly runout concern. Rotate the tire an additional 90 degrees in both the clockwise and the counterclockwise directions to obtain the lowest amount of assembly runout.

Tire and Wheel Assembly-to-Hub/ Axle Flange Match-Mounting

Note: After remounting a tire and wheel assembly to a hub/axle flange, remeasure the tire and wheel assembly on-vehicle runout in order to verify that the amount of runout has been reduced and brought to within tolerances.

1. Mark the location of the high spot on the tire and wheel assembly as determined during the on-vehicle tire and wheel assembly runout measurement.
2. Place a reference mark on the wheel stud that is located closest to the wheel valve stem.
   - Always refer to the reference mark on the wheel stud as the 12 o'clock position.
   - Refer to the location of the high spot by its clock position on the tire and wheel assembly, relative to the marked wheel stud.
3. Remove the tire and wheel assembly from the hub/ axle flange. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
4. Rotate the tire and wheel assembly as close to 180 degrees as possible on the hub/axle flange, so that the wheel valve stem is now approximately at the 6 o'clock position in relation to the marked wheel stud.
5. Reinstall the wheel lug nuts to secure the tire and wheel assembly in the new position. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
6. Remeasure the tire and wheel assembly on-vehicle runout. Mark the new location of the assembly on-vehicle runout high spot on the tire. Refer to *Tire and Wheel Assembly Runout Measurement - On-Vehicle on page 1-53*.
7. If the assembly on-vehicle runout has been reduced and is within tolerance, no further steps are necessary.
8. If the assembly runout has NOT been reduced, perform the following steps:
   8.1. If the clock location of the high spot remained at or near the original clock location of the high spot, the hub/axle flange and/or the brake rotor/drum mounting flange is the major contributor to the assembly on-vehicle runout concern.
   8.2. If the clock location of the high spot is now at or near a position 180 degrees from the original clock location of the high spot, the tire and wheel assembly is the major contributor to the assembly on-vehicle runout concern.
   8.3. If the clock location of the high spot is now in-between the 2 extremes, then both the tire and wheel assembly and the hub/axle flange are contributing to the assembly on-vehicle runout concern. Rotate the tire and wheel assembly as close to an additional 90 degrees as possible in both the clockwise and the counterclockwise directions to obtain the lowest amount of assembly on-vehicle runout.

Description and Operation

Vibration Theory and Terminology

Vibration Theory

The designs and engineering requirements of vehicles have undergone drastic changes over the last several years.

Vehicles are stiffer and provide more isolation from road input than they did previously. The structures of today's stiffer vehicles are less susceptible to many of the vibrations which could be present in vehicles of earlier designs, however, vibrations can still be detected in a more modern vehicle if a transfer path is created between a rotating component and the body of the vehicle.

There are not as many points of isolation from the road in many vehicles today. If a component produces a strong enough vibration, it may overcome the existing isolation and the component needs to be repaired or replaced.

The presence/absence of unwanted noise and vibration is linked to the customer's perception of the overall quality of the vehicle.

Vibration is the repetitive motion of an object, back and forth, or up and down. The following components cause most vehicle vibrations:

- A rotating component
- The engine combustion process firing impulses

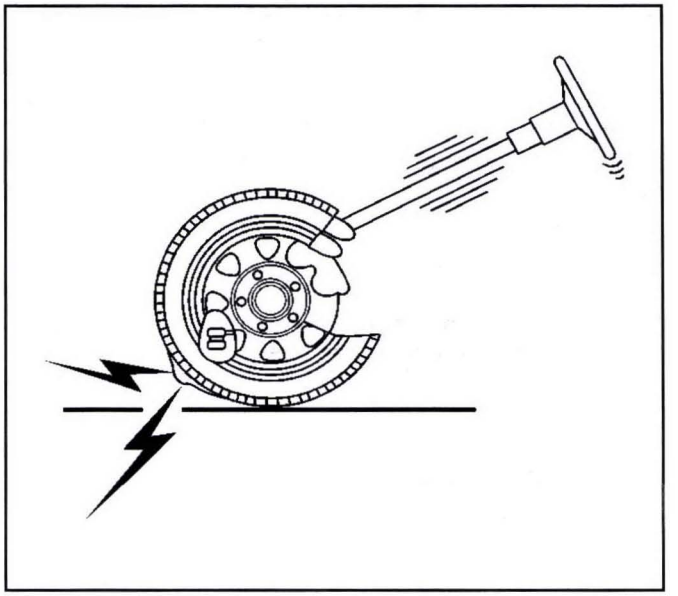
Rotating components will cause vibrations when excessive imbalance or runout is present. During vibration diagnosis, the amount of allowable imbalance or runout should be considered a TOLERANCE and not a SPECIFICATION. In other words, the less imbalance or runout the better.

Rotating components will cause a vibration concern when they are not properly isolated from the passenger compartment: Engine firing pulses can be detected as a vibration if a motor mount is collapsed.

A vibrating component operates at a consistent rate (km/h, mph, or RPM). Measure the rate of vibration in question. When the rate/speed is determined, relate the vibration to a component that operates at an equal rate/ speed in order to pinpoint the source. Vibrations also tend to transmit through the body structure to other components. Therefore, just because the seat vibrates does not mean the source of vibration is in the seat.

Vibrations consist of the following three elements:

- The source – the cause of the vibration
- The transfer path – the path the vibration travels through the vehicle
- The responder – the component where the vibration is felt



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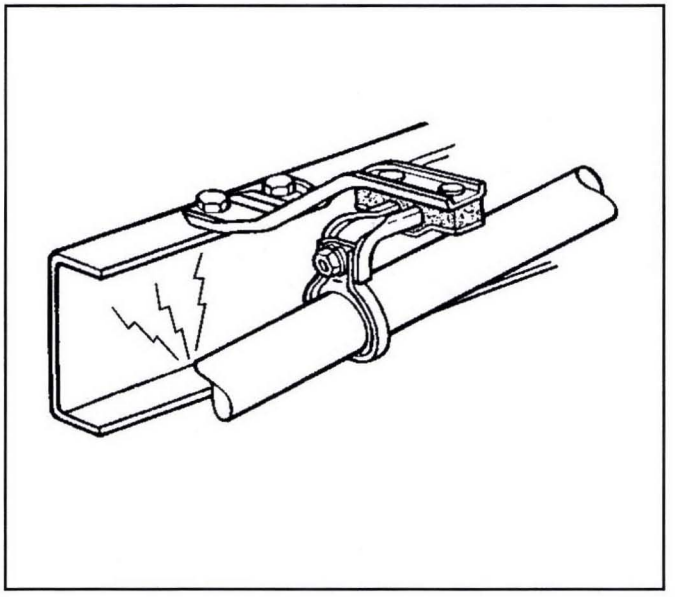
In the preceding picture, the source is the unbalanced tire. The transfer path is the route the vibrations travels through the vehicle's suspension system into the steering column. The responder is the steering wheel, which the customer reports as vibrating. Eliminating any one of these three elements will usually correct the condition. Decide, from the gathered information, which element makes the most sense to repair. Adding a brace to the steering column may keep the steering wheel from vibrating, but adding a brace is not a practical solution. The most direct and effective repair would be to properly balance the tire.



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Vibration can also produce noise. As an example, consider a vehicle that has an exhaust pipe grounded to the frame. The source of the vibration is the engine firing impulses traveling through the exhaust. The transfer path is a grounded or bound-up exhaust hanger. The responder is the frame. The floor panel vibrates, acting as a large speaker, which produces noise. The best repair would be to eliminate the transfer

path. Aligning the exhaust system and correcting the grounded condition at the frame would eliminate the transfer path.

Basic Vibration Terminology

The following are the 2 primary components of vibration diagnosis:

- The physical properties of objects
- The object's properties of conducting mechanical energy

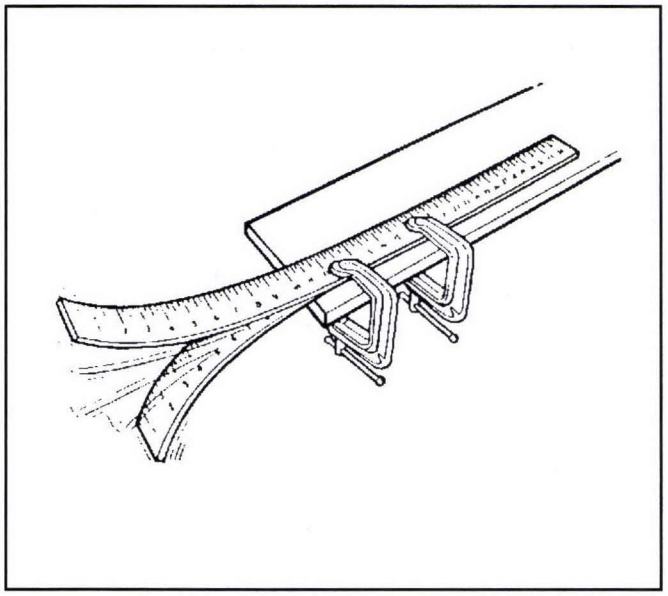
The repetitive up and down or back and forth movement of a component cause most customer vibration complaints. The following are the common components that vibrate:

- The steering wheel
- The seat cushion
- The frame
- The IP

Vibration diagnosis involves the following simple outline:

1. Measure the repetitive motion and assign a value to the measurement in cycles per second or cycles per minute.
2. Relate the frequency back on terms of the rotational speed of a component that is operating at the same rate or speed.
3. Inspect and test the components for conditions that cause vibration.

For example, performing the following steps will help demonstrate the vibration theory:



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1. Clamp a yardstick to the edge of a table, leaving about 50 cm (20 in) hanging over the edge of the table.
2. Pull down on the edge of the stick and release while observing the movement of the stick.

The motion of the stick occurs in repetitive cycles. The cycle begins at midpoint, continues through the lowest extreme of travel, then back past the midpoint, through the upper extreme of travel, and back to the midpoint where the cycle begins again.

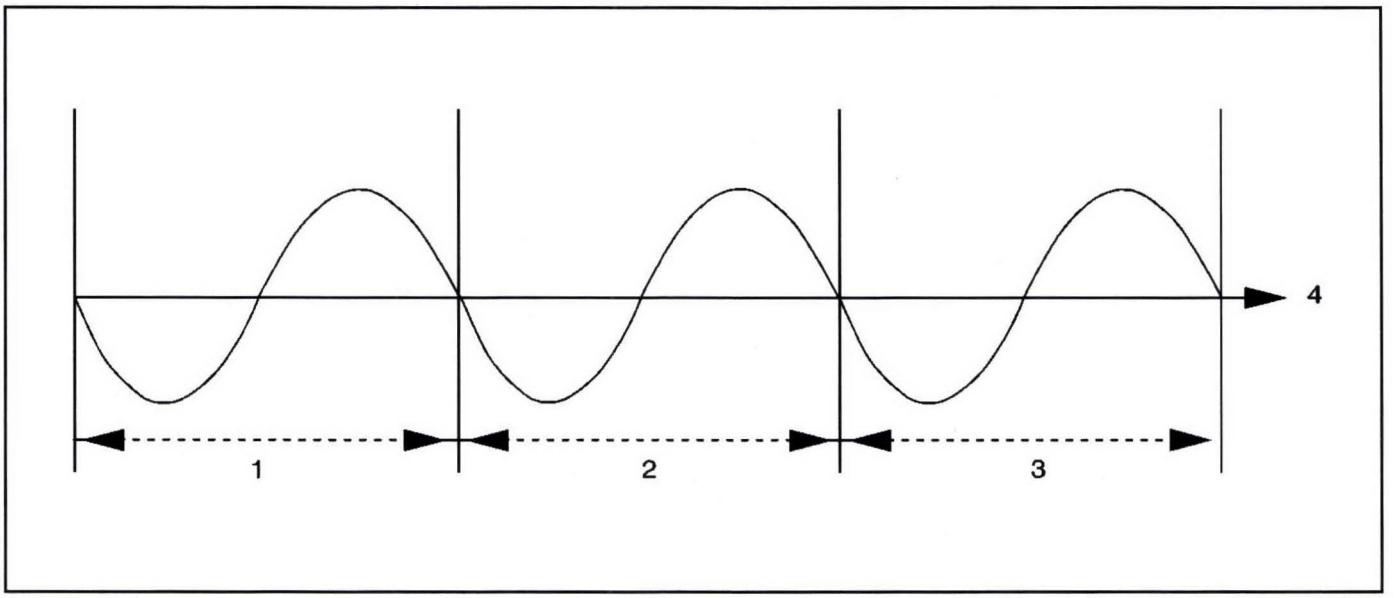
The cycle occurs over and over again at the same rate, or frequency. In this case, about 10 cycles in one second. If we measure the frequency to reflect the number of complete cycles that the yardstick made in one minute, the measure would be 10 cycles x 60 seconds = 600 cycles per minute (cpm).

We have also found a specific amount of motion, or amplitude, in the total travel of the yardstick from the very top to the very bottom. Redo the experiment as follows:

1. Reclamp the yardstick to the edge of a table, leaving about 25 cm (10 in) hanging over the edge of the table.
2. Pull down on the edge of the stick and release while observing the movement of the stick.

The stick vibrates at a much faster frequency: 30 cycles per second (1,800 cycles per minute).

Cycle



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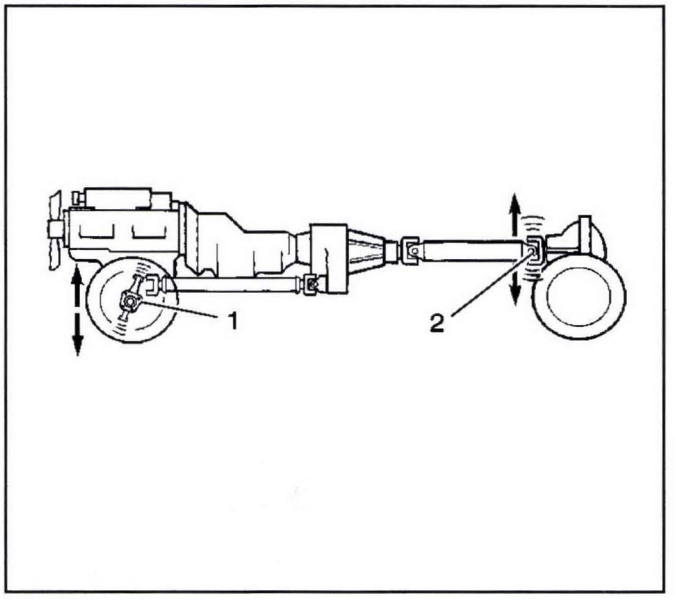
Legend

(1) 1st Cycle
(2) 2nd Cycle
(3) 3rd Cycle
(4) Time

Vibration Cycles in Powertrain Components



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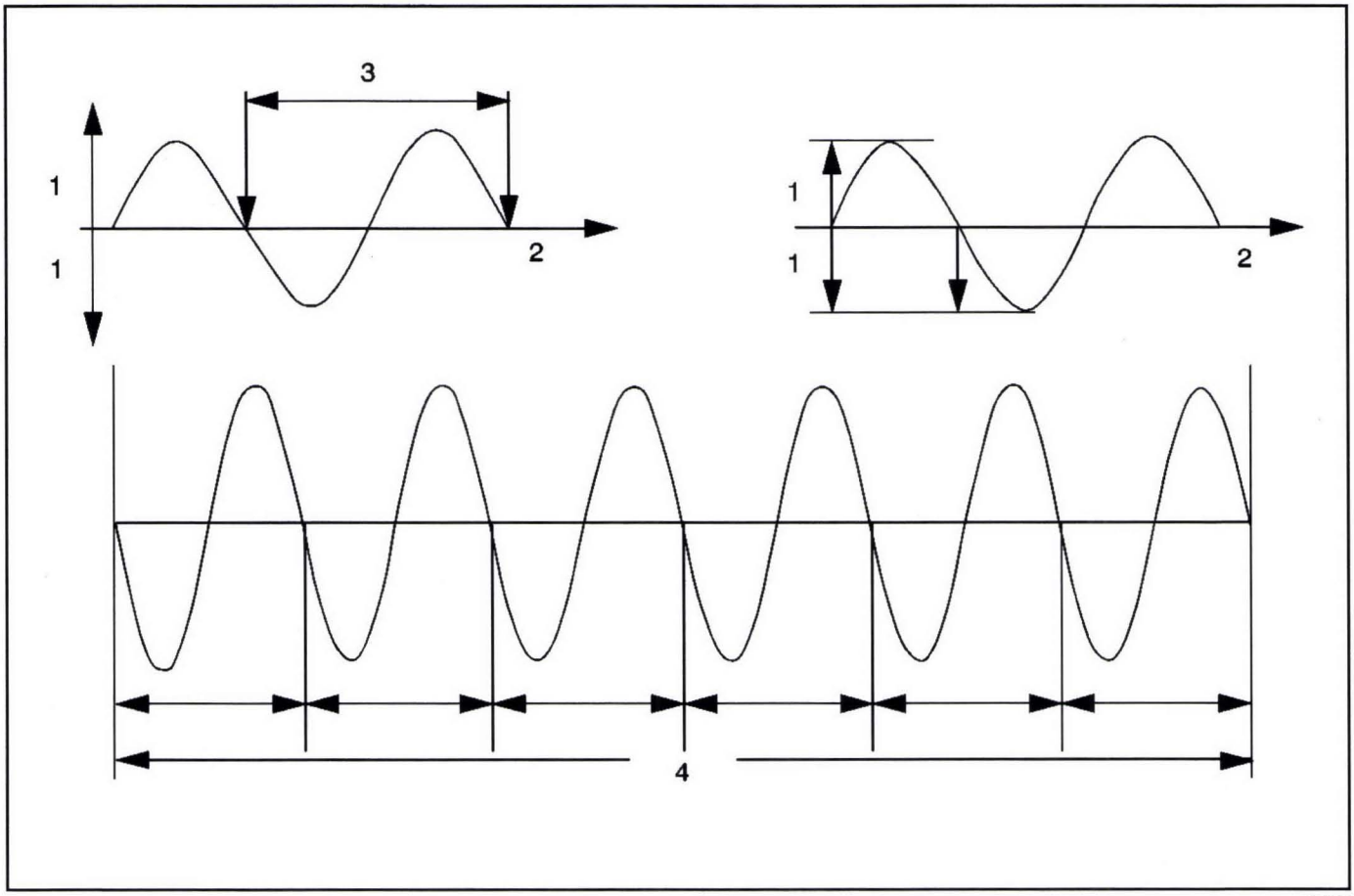
Legend

(1) Spindle
(2) Pinion Nose

The word cycle comes from the same root as the word circle. A circle begins and ends at the same point, as thus, so does a cycle. All vibrations consist of repetitive cycles.

Frequency



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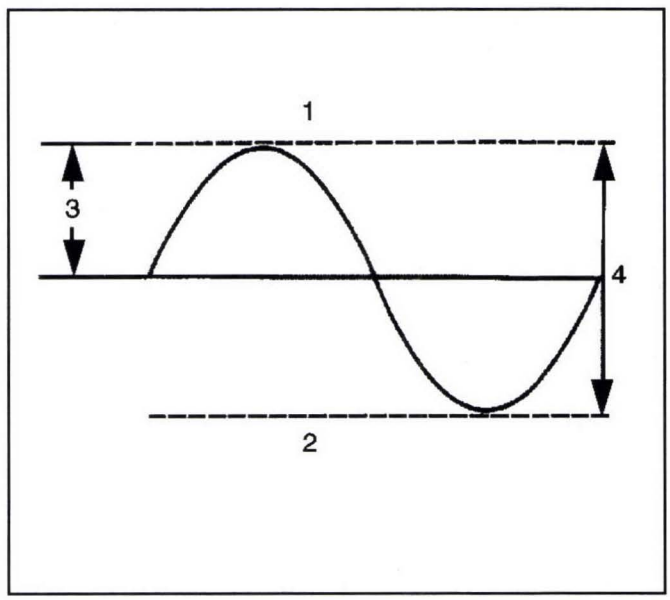
Legend

(1) Amplitude
(2) Reference
(3) Time in Seconds
(4) 1 Second

Frequency is defined as the rate at which an event occurs during a given period of time. With a vibration, the event is a cycle, and the period of time is 1 second. Thus, frequency is expressed in cycles per second.

The proper term for cycles per seconds is Hertz (Hz). This is the most common way to measure frequency. Multiply the Hertz by 60 to get the cycles or revolutions per minute (RPM).

Amplitude



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Legend

(1) Maximum

(2) Minimum
(3) Zero-to-Peak Amplitude
(4) Peak-to-Peak Amplitude

Amplitude is the maximum value of a periodically varying quantity. Used in vibration diagnostics, we are referring it to the magnitude of the disturbance. A severe disturbance would have a high amplitude; a minor disturbance would have a low amplitude.

Amplitude is measured by the amount of actual movement, or the displacement. For example, consider the vibration caused by an out-of-balance wheel at 80 km/h (50 mph) as opposed to 40 km/h (25 mph). As the speed increases, the amplitude increases.

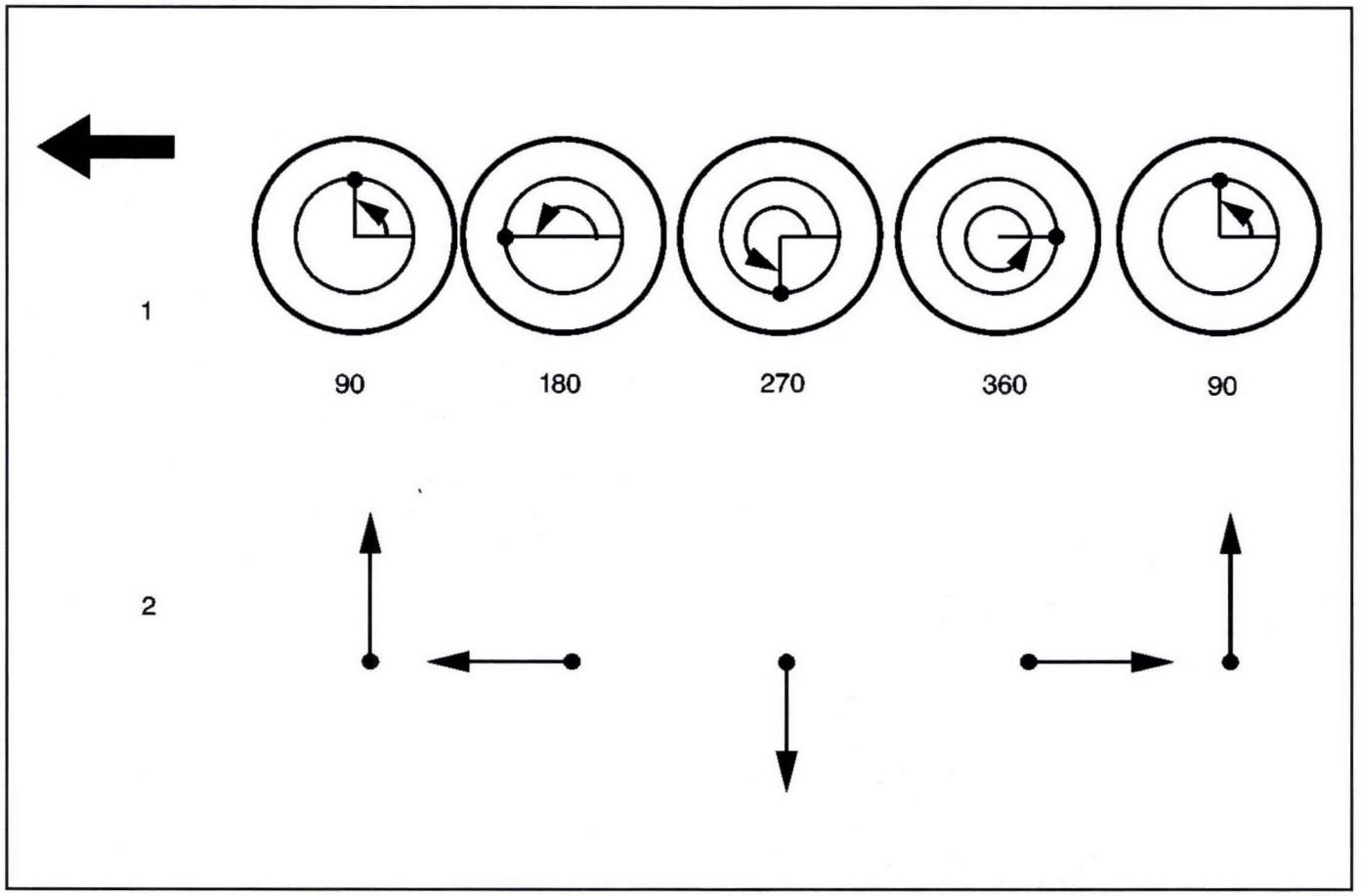
Free Vibration

Free vibration is the continued vibration in the absence of any outside force. In the yardstick example, the yardstick continued to vibrate even after the end was released.

Forced Vibration

Forced vibration is when an object is vibrating continuously as a result of an outside force.

Centrifugal Force Due to an Imbalance



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Legend

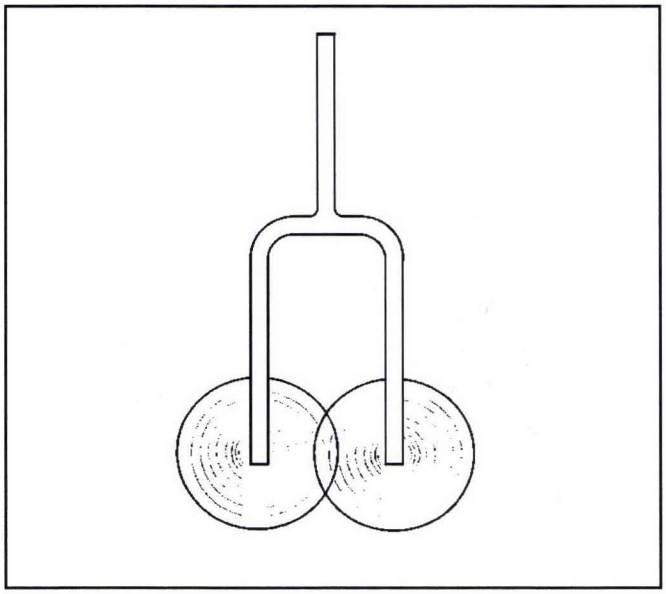
(1) Location of Imbalance (Degrees)
(2) Centrifugal Force Acting on Spindle

A spinning object with an imbalance generates a centrifugal force. Performing the following steps will help to demonstrate centrifugal force:

1. Tie a nut to a string.
2. Hold the string. The nut hangs vertically due to gravity.
3. Spin the string. The nut will spin in a circle.

Centrifugal force is trying to make the nut fly outward, causing the pull you feel on your hand. An unbalanced tire follows the same example. The nut is the imbalance in the tire. The string is the tire, wheel, and suspension assembly. As the vehicle speed increases, the disturbing force of the unbalanced tire can be felt in the steering wheel, the seat, and the floor. This disturbance will be repetitive (Hz) and the amplitude will increase. At higher speeds, both the frequency and the amplitude will increase. As the tire revolves, the imbalance, or the centrifugal force, will alternately lift the tire up and force the tire downward, along with the spindle, once for each revolution of the tire.

Natural or Resonant Frequency



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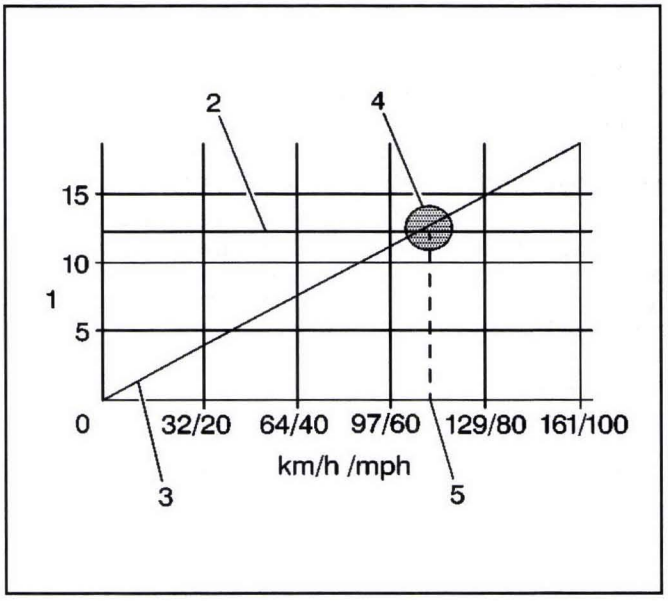
The natural frequency is the frequency at which an object tends to vibrate. Bells, guitar strings, and tuning forks are all examples of objects that tend to vibrate at specific frequencies when excited by an external force.

Suspension systems, and even engines within the mounts, have a tendency to vibrate at certain frequencies. This is why some vibration complaints occur only at specific vehicle speeds or engine RPM.

The stiffness and the natural frequency of a material have a relationship. Generally, the stiffer the material, the higher the natural frequency. The opposite is also true. The softer a material, the lower the natural frequency. Conversely, the greater the mass, the lower the natural frequency.

Resonance



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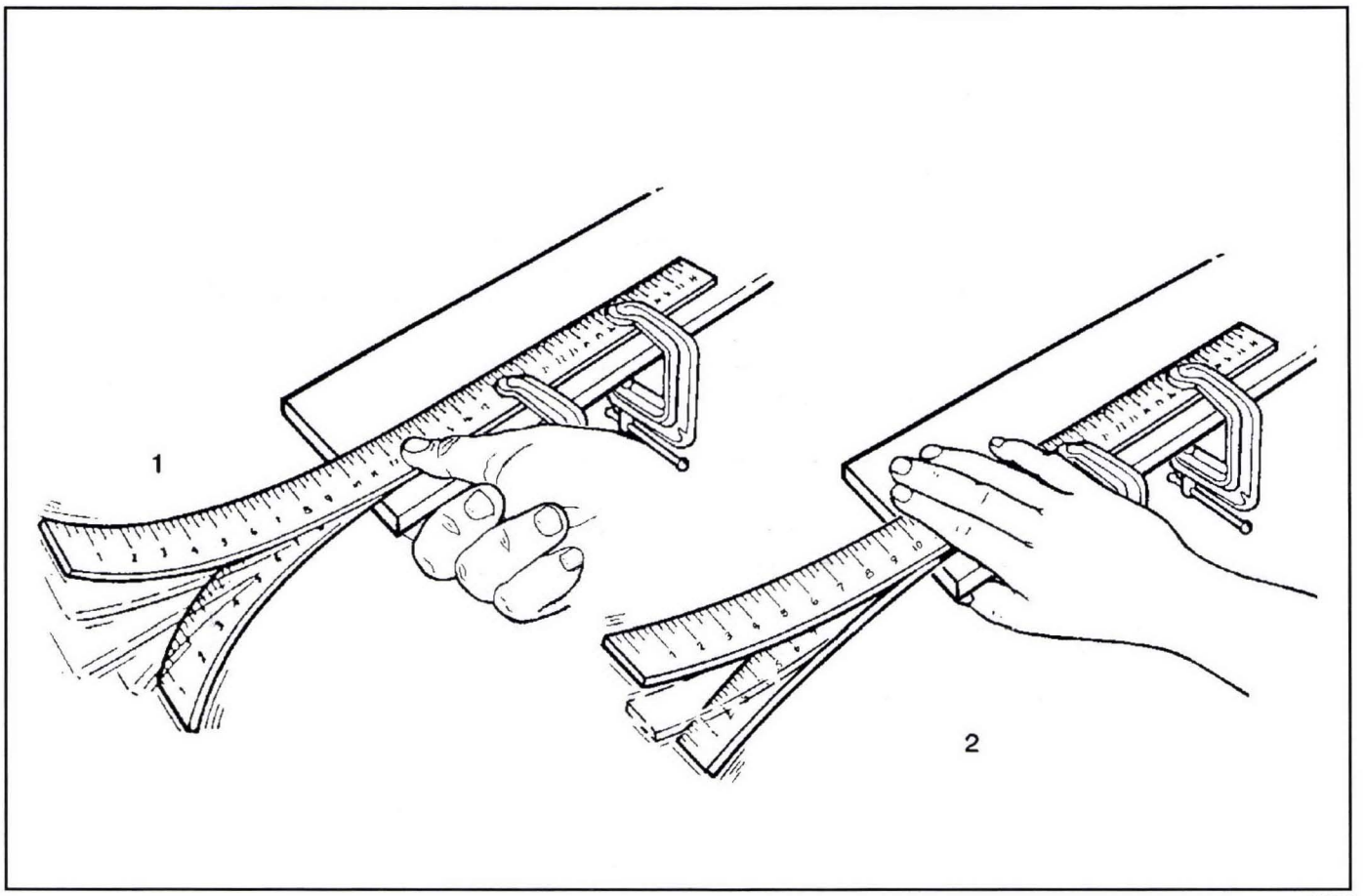
Legend

(1) Frequency – cps
(2) Suspension Frequency
(3) Unbalanced Excitation
(4) Point of Resonance
(5) Problem Speed

All objects have natural frequencies. The natural frequency of a typical automotive front suspension is in the 10–15 Hz range. This natural frequency is the result of the suspension design. The suspension's natural frequency is the same at all vehicle speeds. As the tire speed increases along with the vehicle speed, the disturbance created by the tire increases in frequency. Eventually, the frequency of the unbalanced tire will intersect with the natural frequency of the suspension. This causes the suspension to vibrate. The intersecting point is called the resonance.

The amplitude of a vibration will be greatest at the point of resonance. While the vibration may be felt above and below the problem speed, the vibration may be felt the most at the point of resonance.

Damping



95597

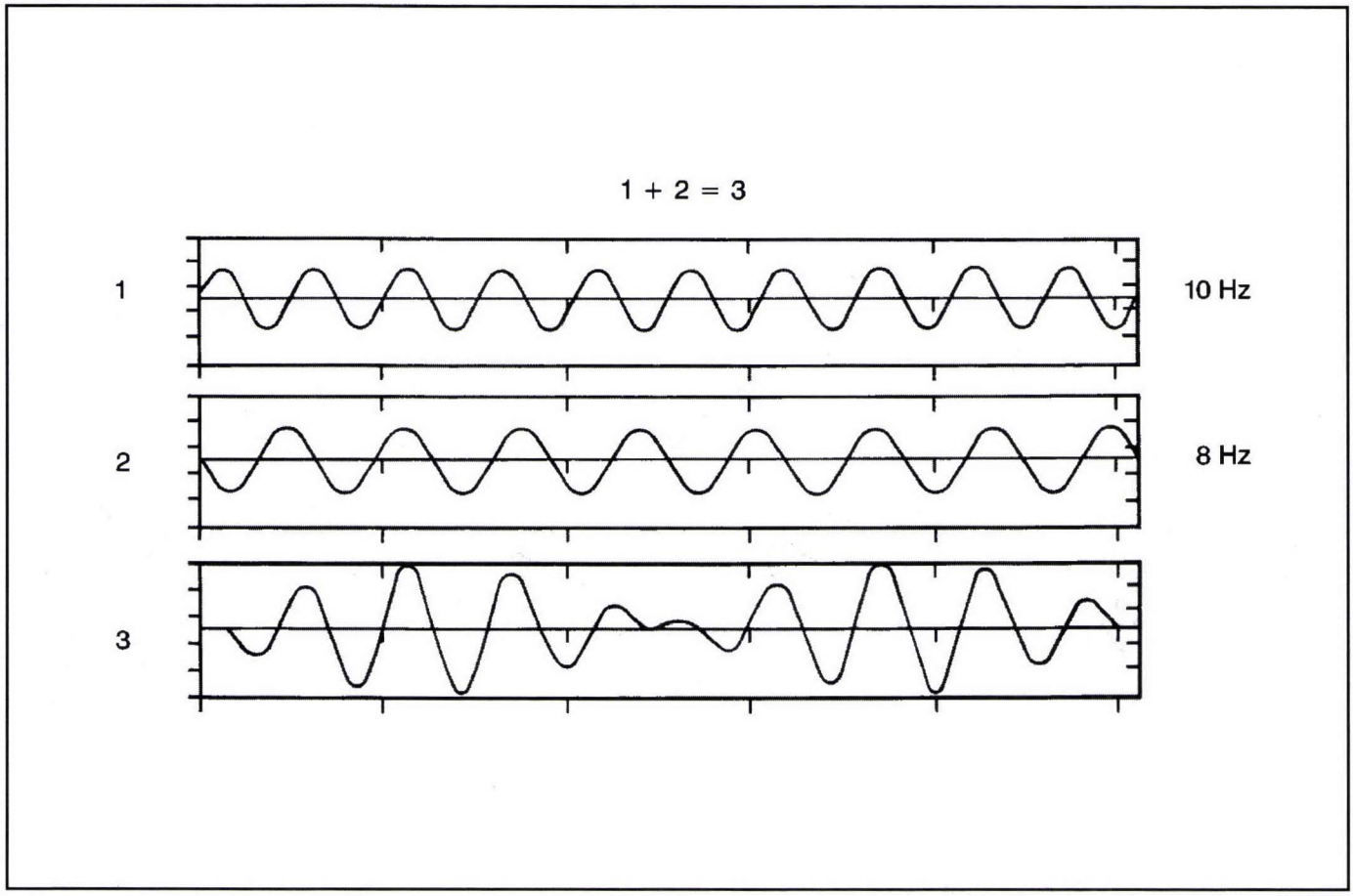
Legend

(1) Low Damping

(2) High Damping

Damping is the ability of an object or material to dissipate or absorb vibration. The automotive shock absorber is a good example. The function of the shock absorber is to absorb or dampen the oscillations of the suspension system.

Beating (Phasing)



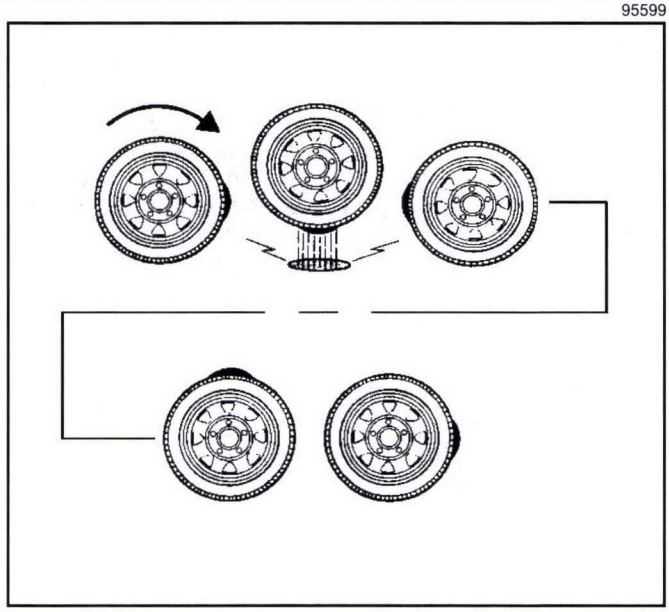
95599

Two separate disturbances that are relatively close together in frequency will lead to a condition called beating, or phasing. A beating vibration condition will increase in intensity or amplitude in a repetitive fashion as the vehicle travels at a steady speed. This beating vibration can produce the familiar droning noise heard in some vehicles.

Beating occurs when 2 vibrating forces are adding to each other's amplitude. However, 2 vibrating forces can also subtract from each other's amplitude. The adding and subtracting of amplitudes in similar frequencies is called beating. In many cases, eliminating either one of the disturbances can correct the condition.

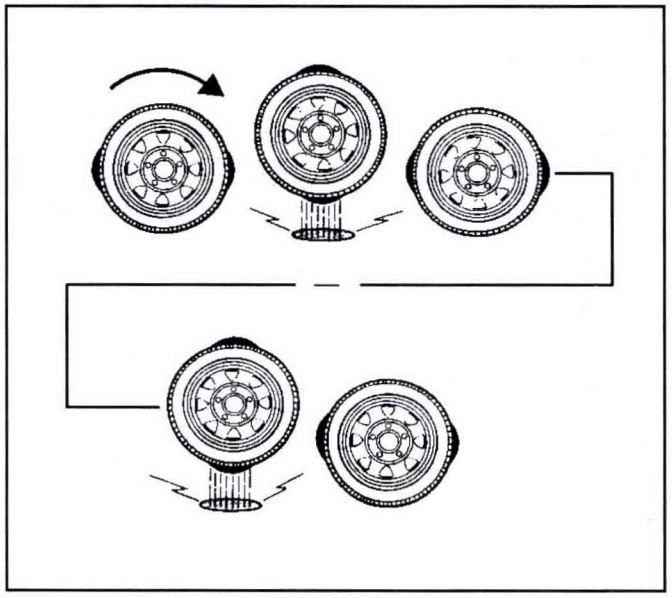
Order

Order refers to how many times an event occurs during 1 revolution of a rotating component.



95600

For example, a tire with 1 high spot would create a disturbance once for every revolution of the tire. This is called first-order vibration.



95601

An oval-shaped tire with 2 high spots would create a disturbance twice for every revolution. This is called second-order vibration. Three high spots would be third-order, and so forth. Two first-order vibrations may add or subtract from the overall amplitude of the disturbance, but that is all. Two first-order vibrations do not equal a second-order. Due to centrifugal force, an unbalanced component will always create at least a first-order vibration.

Electronic Vibration Analyzer (EVA) Description and Operation

Special Tools

- *EL-38792-25* Inductive Pickup Timing Light
- *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2)

For equivalent regional tools, refer to *Special Tools and Equipment on page 1-82*.

The *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2), is a 12–volt powered hand-held device, similar to a scan tool, which receives input from an attached vibration sensor or accelerometer and displays the most dominate input frequency(ies) (up to three) on its liquid crystal display. The vibration concern frequency(ies) are obtained through the use of the *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2) while following the Vibration Analysis Diagnostic Tables. The frequency(ies) obtained, when applied to the Vibration Analysis Diagnostic Tables, are used as a primary input to help determine the source of the vibration concern.

EVA Vibration Sensor

The *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2) vibration sensor incorporates a 6.1 m (20 ft) cord, that allows the sensor to be placed on virtually any component of the vehicle where a vibration concern is felt.

The *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2) contains 2 sensor input ports which can be activated individually to allow for 2 individual vibration sensor inputs. The vibration sensors can then be placed in 2 different locations in the vehicle and their individual inputs can be read without having to stop a test, move the sensor and resume the test. The use of 2 vibration sensors can help in more quickly finding and recording an accurate frequency of the vibration concern, and in more quickly making comparisons between 2 different areas of a single component, or a vehicle system, during the diagnostic process.

EVA Vibration Sensor Placement

Proper placement of the *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2) vibration sensor (accelerometer) is critical to ensure that proper vibration readings are obtained by the *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2). The vibration sensor should be placed on the specific vehicle component identified as being the most respondent to the vibration. If no component has been identified, install the sensor to the steering column as a starting point.

EVA Vibration Sensor-to-Component Attachment

Note: The *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2) vibration sensor must be attached to vehicle components in the manner indicated in order to achieve accurate frequency readings of the vibration disturbance.

The vibration sensor of the *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2) is designed to pickup disturbances which primarily occur in the vertical plane, since most vibrations are felt in that same up-and-down direction. The *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2) vibration sensor is therefore directional sensitive and must be attached to vehicle components such that the side of the sensor marked UP is always facing upright and the sensor body is as close to horizontal as possible. The sensor must be installed in the exact same position each time tests are repeated or comparisons are made to other vehicles.

The *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2) vibration sensor can be attached to vehicle components in various ways. For non-ferrous surfaces, such as the shroud of a steering column, the sensor can be attached using putty, or hook and loop fasteners. For ferrous surfaces, the sensor can be attached using a magnet supplied with the sensor.

EVA Software Cartridge

The *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2) uses a software cartridge, the GE-38792-60, which provides various information to the *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2). The GE-38792-60 provides the *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2) with an additional feature which can be selected and utilized to assist in diagnosing vibration concerns.

Note: The Auto-Mode function of the *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2) cartridge, GE-38792-60, is designed to be used in SUPPORT of the Vibration Analysis Diagnostic Tables ONLY.

This support-feature is available through the *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2) Auto-Mode function. When selected, the *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2) will prompt the

user to select which one of 2 vehicle systems (vehicle speed or engine speed), is the SUSPECTED source of the vibration concern. Using the inputted vehicle data parameters along with the most dominate vibration frequency obtained, it will identify a SUSPECTED source of the vibration concern, such as first-order tire and wheel. This can be a useful feature when used in conjunction with the Vibration Analysis Diagnostic Tables, to confirm results obtained through the diagnostic process.

EVA Smart Strobe Function

The *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2) can be used to identify some rotating components/systems which exhibit imbalance IF the component rotational speed is the dominant frequency of the vibration concern. The *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2) is equipped with a strobe light trigger wire which can be used with an inductive pickup timing light, *EL-38792-25* Inductive Pickup Timing Light, or equivalent included with the GE-38792-25–KIT, or available separately. Using the Smart Strobe function enables the user to input the vibration frequency to which the strobe will flash. By marking the suspected rotating component, such as a pulley, adjusting the strobe frequency to match the dominant vibration frequency at the engine RPM noted during diagnosis, and then operating the engine at that specific RPM, the mark on the object will appear to be stationary if that object is imbalanced.

EVA Strobe Balancing Function

The *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2) can be used to identify the light spot on a propeller shaft IF the propeller shaft rotational speed is the dominant frequency of the vibration concern. The *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2) is equipped with a strobe light trigger wire which can be used with an inductive pickup timing light, *GE-38792-25* Inductive Pickup Timing Light, or equivalent included with the J-38792-25–KIT, or available separately, and in conjunction with the *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2) vibration sensor to identify the light spot on a propeller shaft and to help in making a determination as to when propeller shaft balance is obtained.

Averaging/Non-Averaging Modes

The EVA provides 2 modes of displaying the most dominate frequencies which the EVA vibration sensor (accelerometer) detects; averaging and non-averaging (instantaneous).

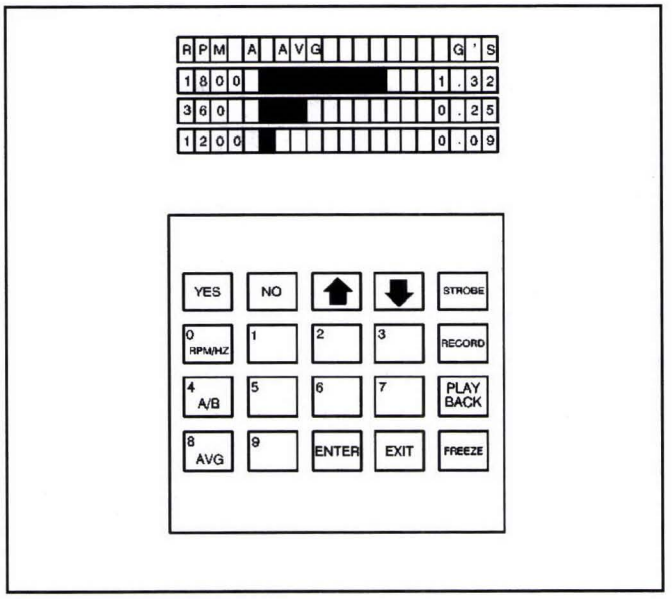
The averaging mode uses multiple vibration samples taken over a period of time and then displays the most dominant frequencies which have been averaged-out. Using the averaging mode minimizes the distractions caused by a sudden vibration frequency being displayed that is not related to the concern vibration, such as from pot holes or from uneven road surfaces.

The non-averaging (instantaneous) mode is more sensitive to vibration disturbances than the averaging mode. Using the non-averaging mode will generate instantaneous frequency displays which are not averaged across multiple samples over a period of time; the specific vibration frequencies that occur at a specific moment during diagnostic testing will be displayed at that moment. The non-averaging (instantaneous) mode is useful when measuring a vibration disturbance that exists for only a short period of time or during acceleration/deceleration testing.

When operating the EVA in the averaging mode along with the Auto Mode, “A” will be displayed along the top of the screen to the left of the vibration sensor input port being used. When operating the EVA in the averaging mode and the Manual Mode, “AVG” will be displayed along the top center of the screen.

When operating the EVA in the non-averaging (instantaneous) mode along with the Auto Mode, “I” will be displayed along the top of the screen to the left of the vibration sensor input port being used. When operating the EVA in the non-averaging (instantaneous) mode and the Manual Mode, the top center of the screen will be blank.

EVA Display



95605

The most dominant input frequencies, up to three, received from the *EL-38792-A* Electronic Vibration Analyzer 2 (EVA 2) vibration sensor, are displayed in descending order of amplitude strength.

The frequency readings are displayed along the left side of the screen, followed to the right by either a bar graph or the suspected source of the vibration – depending upon the mode selected, then the amplitude reading for each frequency along the right side of the screen. The top row of the screen indicates the units of measure being displayed for the frequencies along the left side and for the amplitudes along the right side. The top row also indicates the vibration sensor input port which was selected on the keypad (A or B) and which mode was selected: averaging or non-averaging (instantaneous).

The frequency(ies) can be displayed in either revolutions per minute (RPM) or revolutions per second; Hertz (Hz). The selected display type (RPM or Hz) will be indicated at the left side of the screen, above the frequency readings.

When the AUTO MODE function is not in use, a bar graph is displayed next to each frequency to provide a quick visual indication of the relative amplitude strength.

When the AUTO MODE function is being used, the suspected source of the vibration is displayed next to each frequency to provide support to the diagnostic process.

The actual amplitude strength of each frequency is displayed at the right side of the screen and shown in G's-of-acceleration force.

Oscilloscope Diagnostic Kit Description and Operation

Special Tools

- *CH-51450-NVH* Oscilloscope Diagnostic Kit (w/NVH)
- *EL-47966* Multi Diagnostic Interface MDI

For equivalent regional tools, refer to *Special Tools and Equipment on page 1-82*.

The *CH-51450-NVH* Oscilloscope Diagnostic Kit (w/NVH) is an automotive oscilloscope which receives input from an attached accelerometer and displays all input frequencies on a laptop or tablet computer. The vibration concern frequency(ies) are obtained through the use of the *CH-51450-NVH* Oscilloscope Diagnostic Kit (w/NVH) hardware, while vehicle component speed data is gathered through the *EL-47966* Multi Diagnostic Interface MDI. The MDI data is integrated into the Oscilloscope software so that vibration(s) can be tied to specific vehicle components based on their speed to determine the source of the vibration concern.

Oscilloscope Inputs

The *CH-51450-TA183* accelerometer incorporates a 3 m (9.8 ft) cord that allows the sensor to be placed on virtually any component of the vehicle where a vibration concern is felt. The accelerometer uses a self-powered NVH interface module. The NVH interface module uses a replaceable battery. Input B is the default port for a single accelerometer. The cord used to connect the NVH interface module to the *CH-51450-NVH* Oscilloscope is 5 m (16.4 ft) long.

Input D is used for the *CH-51450-TA186* optical tachometer sensor which is used during driveline balancing. It incorporates a 2.5 m (8.2 ft) cord and a 5 m (16.4 ft) cord.

There is also an optional microphone that can be used with the *CH-51450-NVH* Oscilloscope.

Oscilloscope Accelerometer Placement

Proper placement of the *CH-51450-TA183* accelerometer is critical to ensure that proper vibration readings are obtained by the *CH-51450-NVH* Oscilloscope. The accelerometer should be placed on the drivers side inboard seat track. Once a baseline reading has been taken, the accelerometer can be placed on the point of the customer concern to verify what the customer is hearing or feeling.

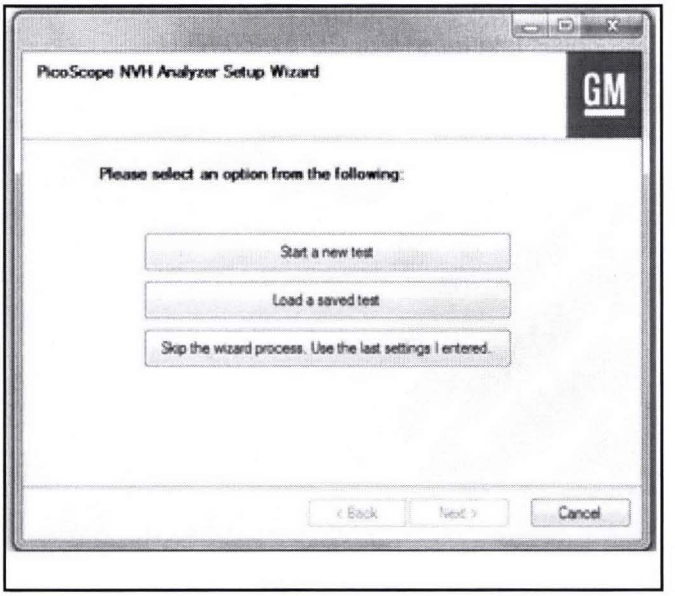
Oscilloscope Accelerometer-to-Component Attachment

Note: The *CH-51450-TA183* accelerometer must be attached to vehicle components in the manner indicated in order to achieve accurate frequency readings of the vibration disturbance.

The accelerometer of the *CH-51450-NVH* Oscilloscope is designed to pick up disturbances which primarily occur in the vertical plane, since most vibrations are felt in that same up-and-down direction. The *CH-51450-TA183* accelerometer is therefore directionally sensitive, and must be attached to vehicle components such that the cord end is always facing upright, and the sensor body is as close to horizontal as possible. The sensor must be installed in the exact same position each time tests are repeated, or comparisons are made to other vehicles.

The *CH-51450-TA183* accelerometer can be attached to vehicle components in various ways. For non-ferrous surfaces, such as the shroud of a steering column, the sensor can be attached using putty, or hook and loop fasteners. For ferrous surfaces, the sensor can be attached using the *CH-51450-TA096* magnet supplied with the sensor. For hard aluminum surfaces, a ferrous washer can be glued on using a cyanoacrylate (super glue) and then the magnet can be used.

NVH Software Set-up

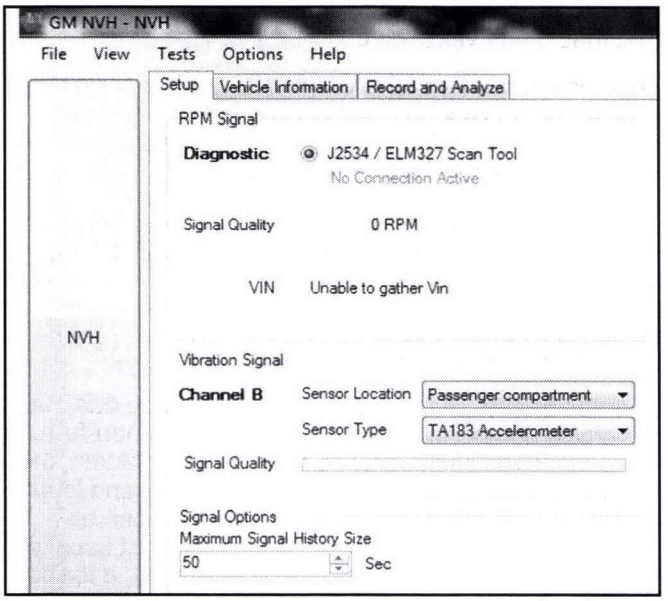


3681642

When the NVH software is first opened and the NVH tab is selected, there is a set-up wizard within the *CH-51450-NVH* NVH software which has a step-by-step guide to ensure the *CH-51450-NVH* Oscilloscope and MDI are connected correctly, and to input the vehicle information.

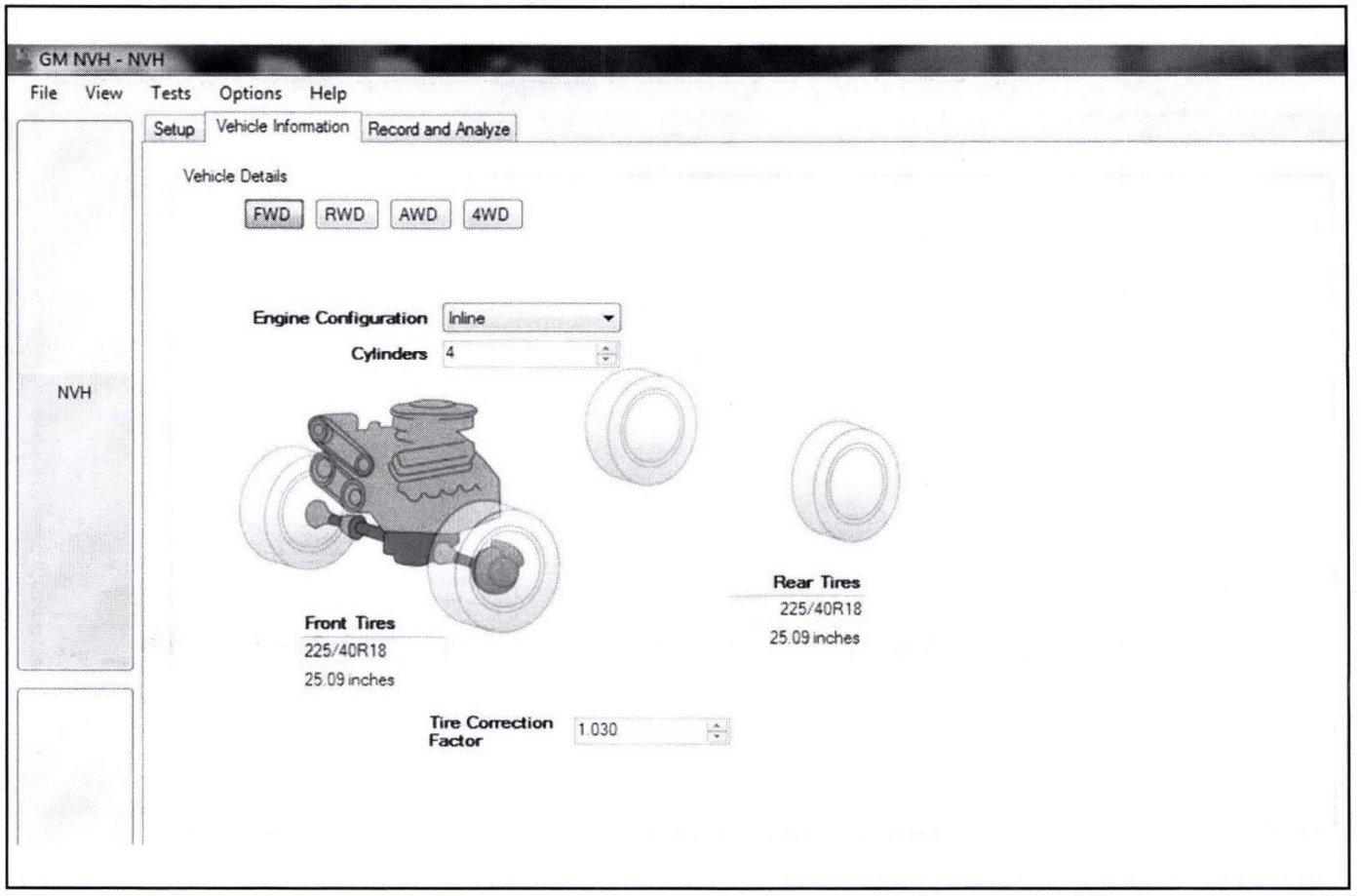
Oscilloscope NVH Display

The *CH-51450-NVH* Oscilloscope display consists of three tabs:



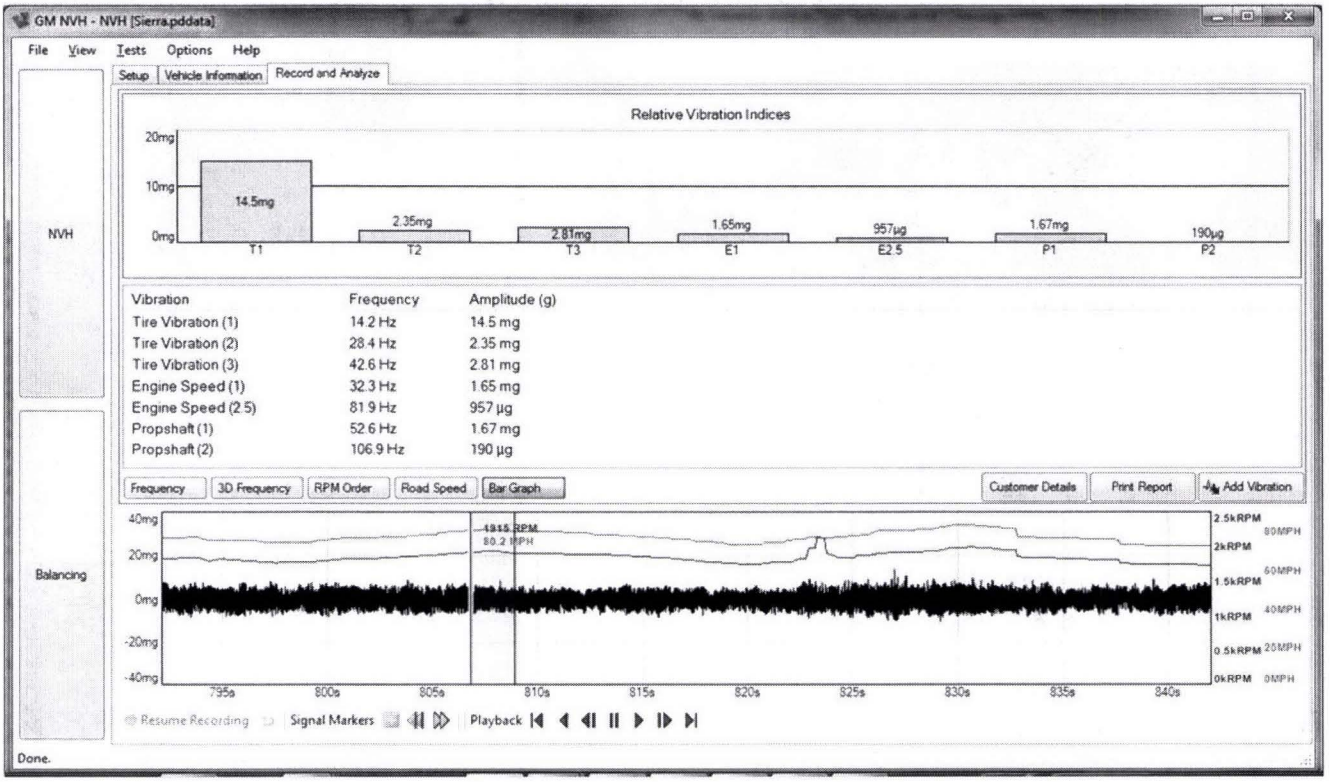
3681739

The first tab is set-up. The set-up information can be entered here if not already done through the set-up wizard. It can also be updated here, if necessary. A laptop or desktop computer, *EL-47966* Multi Diagnostic Interface MDI, *CH-51450-NVH* Oscilloscope, *CH-51450-TA148* NVH interface, and *CH-51450-TA183* accelerometer are needed to do a vibration analysis.



3681746

The second tab is vehicle information. The vehicle information can be entered here if not already done through the set-up wizard. It can also be updated here, if necessary.



3681750

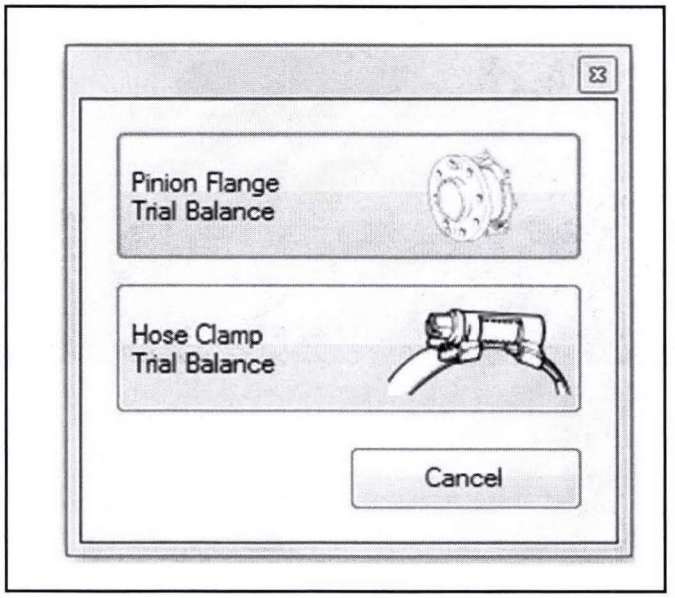
The third tab is the record and analyze tab. The standard display will show the known input frequencies received from the *CH-51450-TA183* accelerometer as a bar graph at the top of the screen. At the middle of the screen, the input frequencies are listed as text. The frequency(ies) are displayed in Hertz (Hz). If desired, the frequency(ies) can be displayed in RPM by clicking Options, then Advanced Options. The actual amplitude strength of each frequency is displayed and shown in g's of acceleration (expressed to the thousandth of a force of gravity, or "milli-g"). At the bottom of the screen, it also shows a plot of all frequency inputs along with engine speed in blue, and vehicle speed in red. The data can be saved in 50 second increments. The data can then be saved by clicking File, then Save. Files that are saved can then be loaded into the software by clicking File, then Load.

Oscilloscope Balancing

The *CH-51450-NVH* Oscilloscope with balancing software can be used to identify some rotating component/systems which exhibit imbalance IF the component rotational speed is the dominant frequency of the vibration concern. The *CH-51450-NVH* Oscilloscope is used with the *CH-51450-TA186* optical tachometer sensor. The optical tachometer sensor directly measures component rotational speed so a known weight can be added for a baseline reading. Then the oscilloscope will determine where to add a specific amount of weight to the component.

For example, the *CH-51450-NVH* Oscilloscope can be used to balance the driveline on rear wheel drive and all wheel drive vehicles. The methods that can be employed are a tuned weight approach for drivelines that use couplers and a dual hose clamp approach for drivelines that use CV or two-axis universal joints. The balancing process consists of the *CH-51450-TA186* optical tachometer sensor to directly read the driveline speed and software that directs where the weights should be placed depending on the type of driveline/ propeller shaft being balanced.

Oscilloscope Balancing Software Set-up

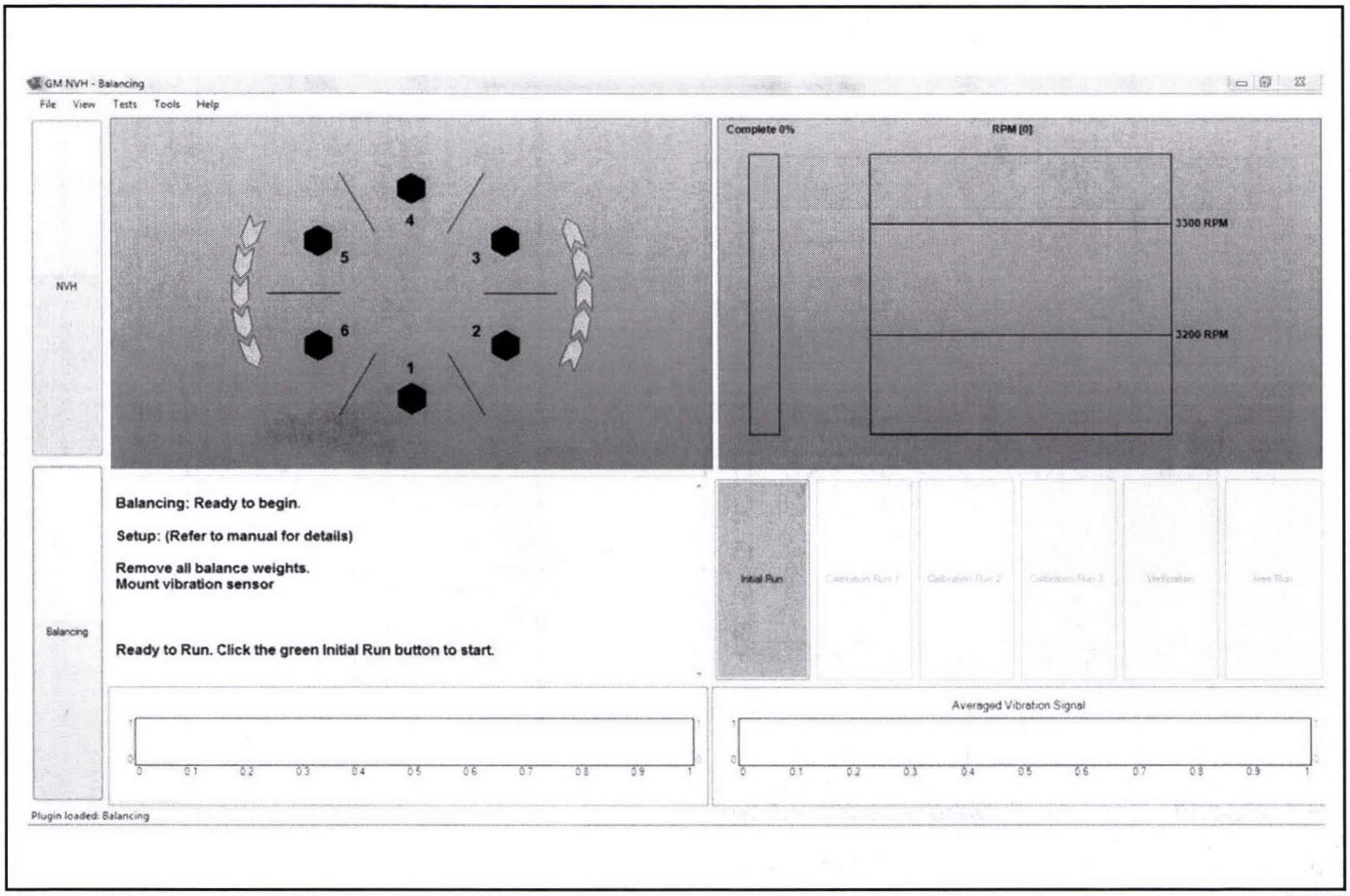


3681761

When the NVH software is first opened and the Balancing tab is selected, a pop-up box within the *CH-51450-NVH* balancing software will ask which type of balancing method is to be used. The two methods are pinion flange or hose clamp. Then either the wizard (which will walk through the connections and input data) or advanced configuration can be chosen to input the initial information and start the balancing procedure.

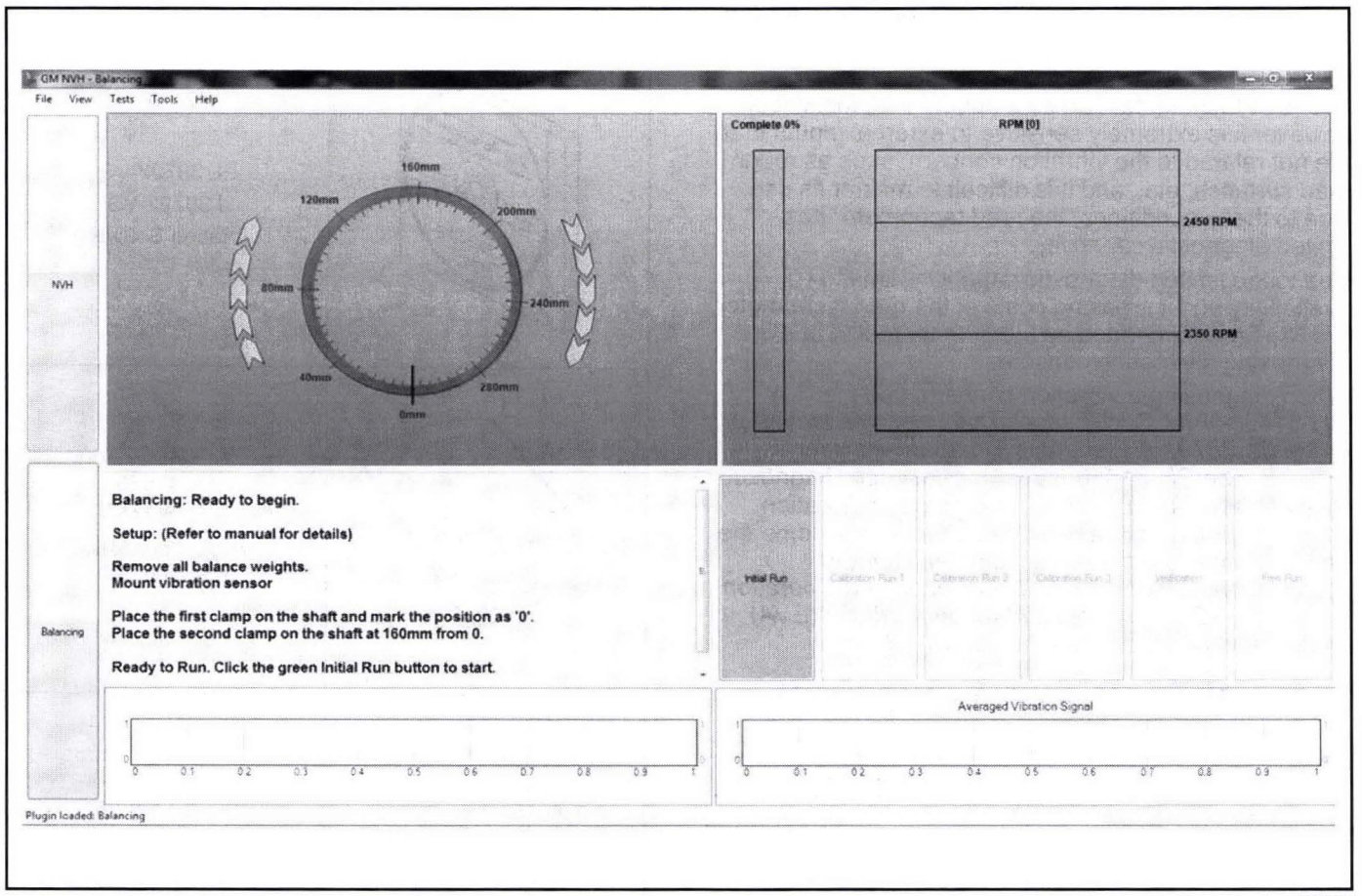
Oscilloscope Balancing Display

The propeller shaft balancing will consist of an initial run, three calibration runs, and a verification run. The software will walk through what is required for each run.



3681762

An example of the pinion flange balancing screen is shown above.



3681763

An example of the hose clamp balancing screen is shown above.

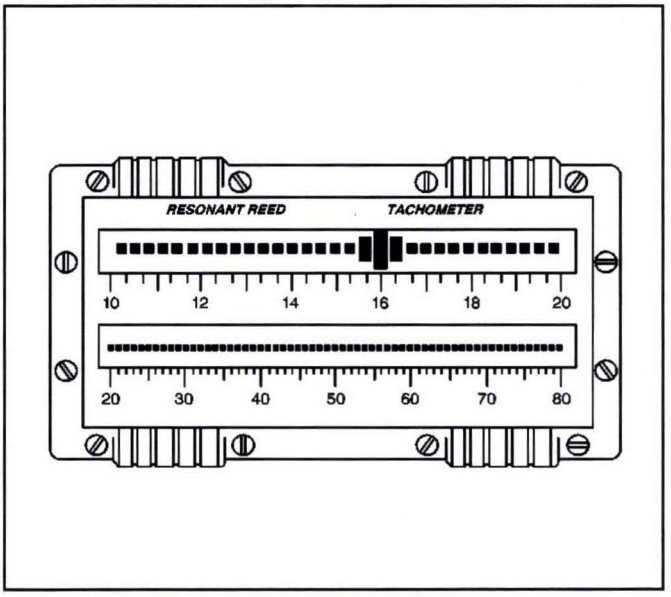
Vibrate Software Description and Operation

The *EL-38792-VS* Vibrate Software, is a computer software program which is designed to be used in support of the Vibration Analysis diagnostic tables, along with the *EL-38792-A* Electronic Vibration Analyzer (EVA) 2, and a scan tool, to help in determining the source of a vibration concern. The *EL-38792-VS* Vibrate Software is designed to provide quick calculations and produce a chart of the rotational speeds and frequency ranges for specific vehicle systems and components, based upon vehicle data parameters inputted by the user.

The *EL-38792-VS* Vibrate Software uses the vehicle data parameters, such as axle ratio, number of engine cylinders, etc. to create the base chart, depicting the relationships of the various vehicle systems and/or components. The chart view can be modified to show data related to vehicle speed only, engine speed only, or both vehicle speed and engine speed. The user can then plot the dominant frequency reading obtained on the *EL-38792-A* Electronic Vibration Analyzer (EVA) 2 which correlates with the vibration concern, and the engine RPM obtained on a scan tool which correlates with the concern. Once these pieces of data are correctly plotted, the chart will point to the source of the vibration concern, which should confirm the results obtained through the Vibration Analysis diagnostic tables.

The *CH-51450-NVH* Oscilloscope Diagnostic Kit (w/ NVH) includes a version of the vibrate software within its help file.

Reed Tachometer Description



386790

The reed tachometer consists of 2 rows of reeds arranged side-by-side. Each reed is tuned to vibrate or resonate when it is excited by a specific frequency. The reeds are arranged by their specific resonant frequency, increasing from left to right, ranging from

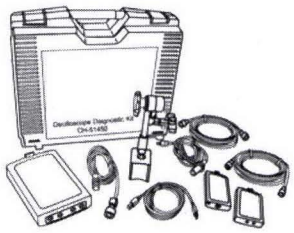
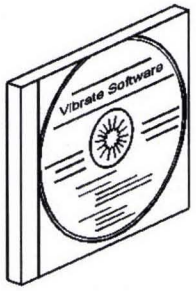
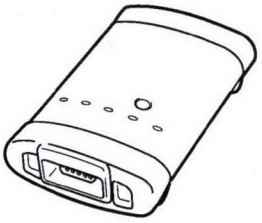
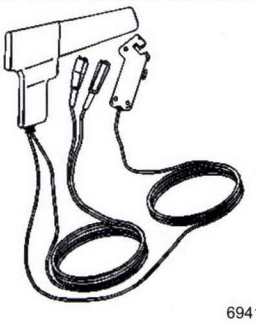
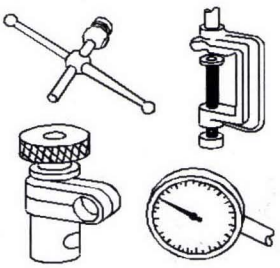
10–80 Hz. This arrangement allows for a visual display of the most dominate frequencies which fall within this range.

The reed tachometer can be a helpful diagnostic tool, however it is extremely sensitive to external inputs that are not related to the vibration concern, such as rough road surfaces, etc., and it is difficult to master its use. Due to these conditions, the reed tachometer has limited diagnostic capability.

Due to the limited diagnostic capability, limited availability and increasing costs of the reed tachometer, it is NOT recommended as the primary tool to use in diagnosing a vibration concern.

When diagnosing a vibration concern, use the *CH-51450-NVH* Oscilloscope Diagnostic Kit (w/NVH) or the *EL-38792-A* Electronic Vibration Analyzer (EVA) 2. The *CH-51450-NVH* Oscilloscope Diagnostic Kit (w/NVH) or thd *EL-38792-A* Electronic Vibration Analyzer (EVA) 2 have been designed to overcome the shortcomings to the reed tachometer. Refer to *Oscilloscope Diagnostic Kit Description and Operation on page 1-75* or *Electronic Vibration Analyzer (EVA) Description and Operation on page 1-73*.

Special Tools and Equipment

Illustration	Tool Number/Description
 3671271	CH 51450-NVH Oscilloscope Diagnostic Kit (w/NVH)
694161	EL 38792-A J 38792-A Electronic Vibration Analyzer (EVA) 2
 694124	EL 38792-VS J 38792-VS Vibration Software
 2191416	EL 47955 J 2534 Multi Diagnostic Interface MDI
 694115	EN 38792-25 J 38792-25 Inductive Pickup Timing Light
 2014	GE 8001 J 8001 Dial Indicator Set

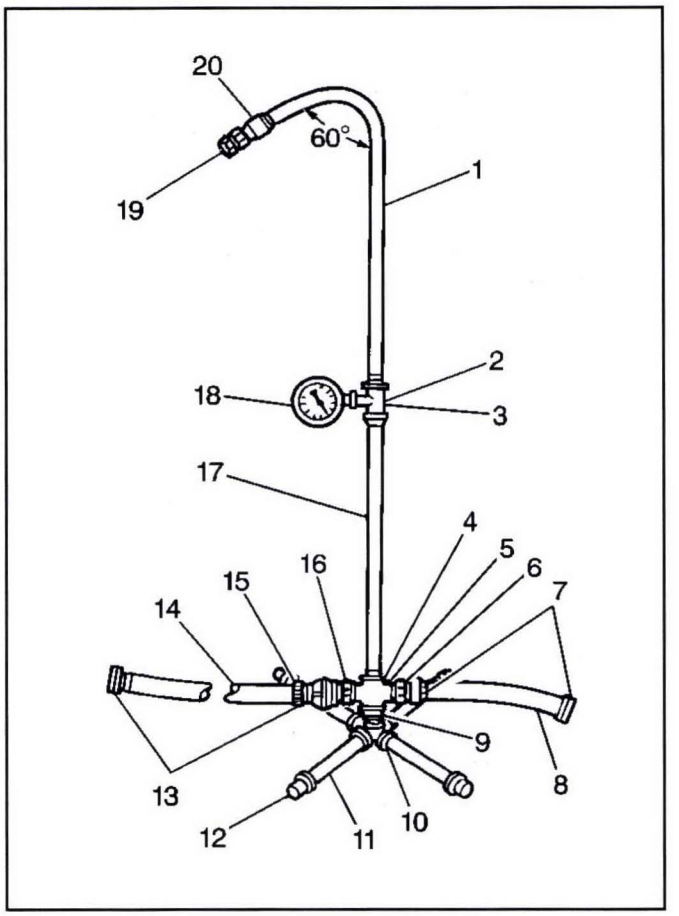
Waterleaks

Diagnostic Information and Procedures

Waterleak Test Preparation

- GM vehicles are designed to operate under normal environmental conditions.
- The design criteria for sealing materials and components takes into consideration the sealing forces required to withstand the natural elements. These specifications cannot take into consideration any artificial conditions, i.e., high pressure car washes.
- The water leak test procedure has been correlated to the natural elements and will determine the ability of a vehicle to perform under normal operating conditions.
- The first step in diagnosing a leak is determining the conditions under which a leak occurs. If the general leak area can be found, the exact entry point can be isolated using a water hose or an air hose. Some trim panels or components may need to be removed in order to repair the leak.
- If leaks are found around a door, door window, rear compartment lid or liftgate area this does not necessarily indicate a bad weatherstrip. An adjustment to these areas may resolve the condition.

Watertest Stand Assembly



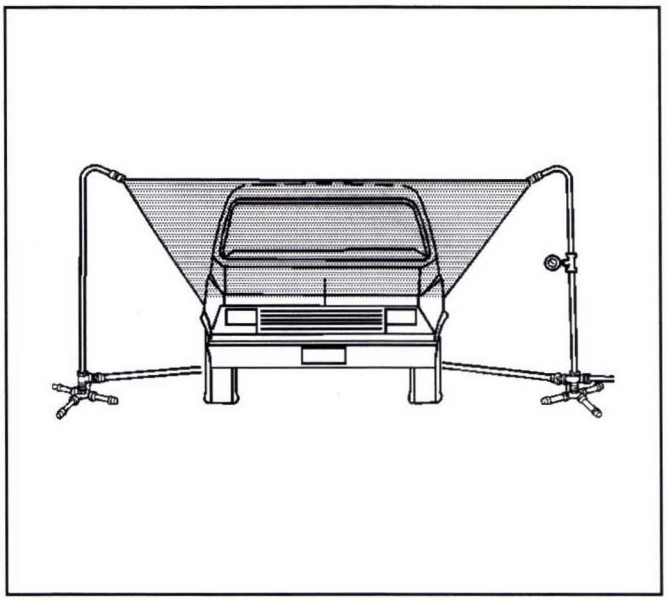
154169

Legend

(1) Pipe (0.5 x 36 in)
(2) Reducing Tee, Right Stand Only (0.5 x 0.5 x 0.25 in)
(3) Coupling, Left Stand Only, (0.5 in)
(4) Tee, Left Stand Only (0.5 in)
(5) Cross, Right Stand Only (0.5 in)
(6) Pipe to Hose Nipple, Right Stand Only (0.5 in)
(7) Female Hose Coupling (5/8 in)
(8) Input Hose, Right Stand Only (2.0 ft) (5/8 in diameter)
(9) Close Nipple (0.5 in)
(10) Cross (0.5 in) with Weld-On Cap (0.5 in)
(11) Nipple (0.5 x 12 in)
(12) Cap (0.5 in)
(13) Female Hose Coupling (5/8 in)
(14) Cross Hose (12 ft) (5/8 in diameter)
(15) Hose Quick Connect
(16) Pipe to Hose Nipple (0.5 in)
(17) Pipe (0.5 x 60 in)
(18) Water Pressure Gauge, Right Stand Only
(19) Full Jet Spray Nozzle, No. 1/2GG-25 or Equivalent

(20) Coupling (0.5 in)

1. Assemble the water test stand as shown.



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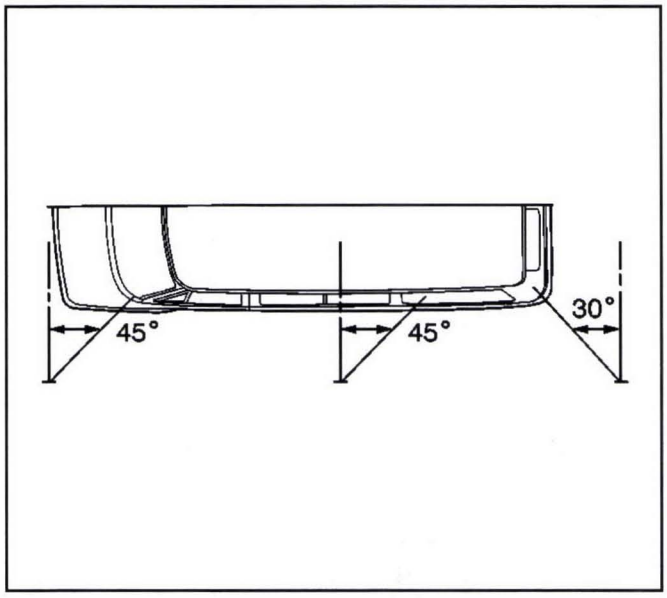
2. Position the stands as shown. The water spray from the stands should overlap the vehicle as shown.
3. Have an assistant inside of the vehicle during the test in order to locate any leaks.
4. The water pressure at the nozzle should maintain a 155 kPa (22 psi), for at least 4 minutes.



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5. In order to check the windshield, aim the water spray 30 degrees down and 45 degrees toward the rear.

   Aim the water towards the corner of the windshield.
6. In order to check the side windows for leaks, position the water stand towards the center of the rear quarter, aiming the water spray 30 degrees down and 45 degrees toward the rear.
7. In order to check the back window, aim the water spray 30 degrees down and 30 degrees toward the front.

Dust Leaks

Dust may leak into the vehicle where water will not. This happens particularly in the lower portion of the interior.

Forward motion of the vehicle can create a slight vacuum which pulls air and dust into the vehicle.

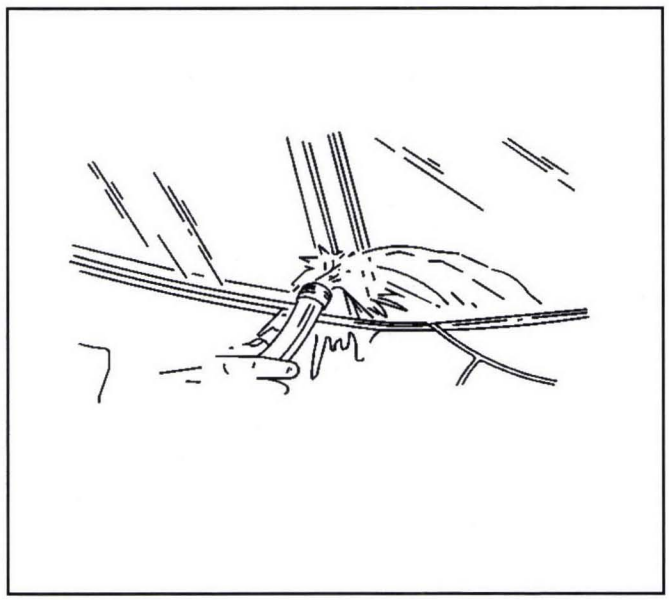
In order to determine the location of dust leaks, perform the following steps:

1. Remove the mats from the floor.
2. Remove the mats from the kick panel.
3. Remove the insulation from the floor.
4. Remove the insulation from the kick panel.
5. Drive the vehicle on a dusty road.
6. Examine the interior.

   Dust in the shape of a small cone or slit will usually be found at the point of leakage.
7. Mark the points of leakage.

   Note: Ensure that the interior is darkened when performing this step.
8. Shine bright lamps on the underside of the floor and the cowl.
9. Have an assistant mark any points inside of the vehicle for any points where the light shines through.
   - Inspect the weld joints.
   - Inspect the body mounts.
10. Seal any leaks with an air-drying, body-sealing compound.

Water Hose Test



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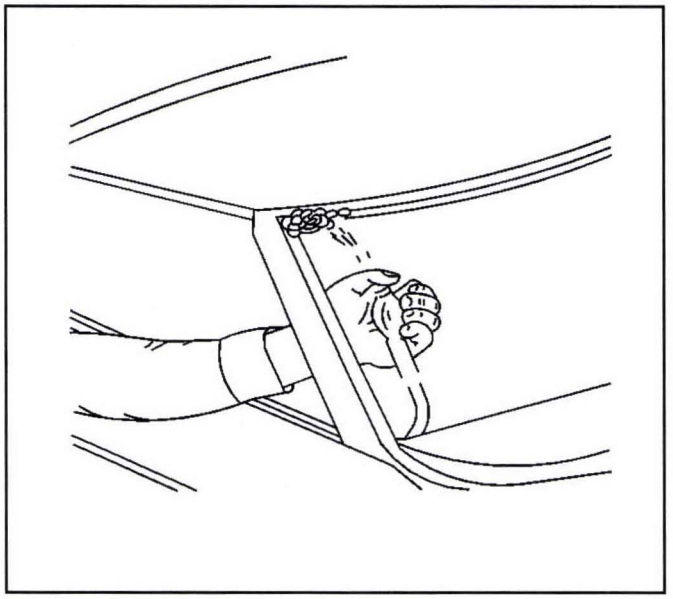
Note: Use a water hose without the nozzle attached.

1. Have an assistant inside of the vehicle in order to locate the leak.
2. Begin testing at the base of the window or the windshield.
3. Slowly move the hose upward and across the top of the vehicle.

Air Hose Test



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Caution: The air hose test should only be used on fully cured urethane adhesive. Otherwise, damage to the urethane adhesive bead could result in additional leaks.

1. Using a liquid detergent, diluted with water in a spray bottle, spray the window at the edges. Begin at the bottom and gradually move up and across the top.

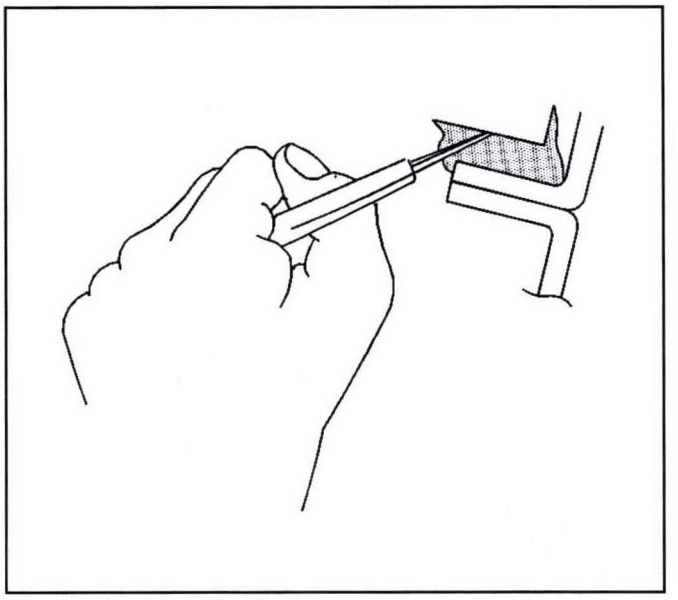
   Note: The compressed air should not exceed 205 kPa (30 psi).

2. Have an assistant inside of the vehicle with an air hose.
3. Have the assistant aim the compressed air at the suspected areas.

   Bubbles will form in the soap solution at the location of the leak.

Repair Instructions

Body Waterleak Repair



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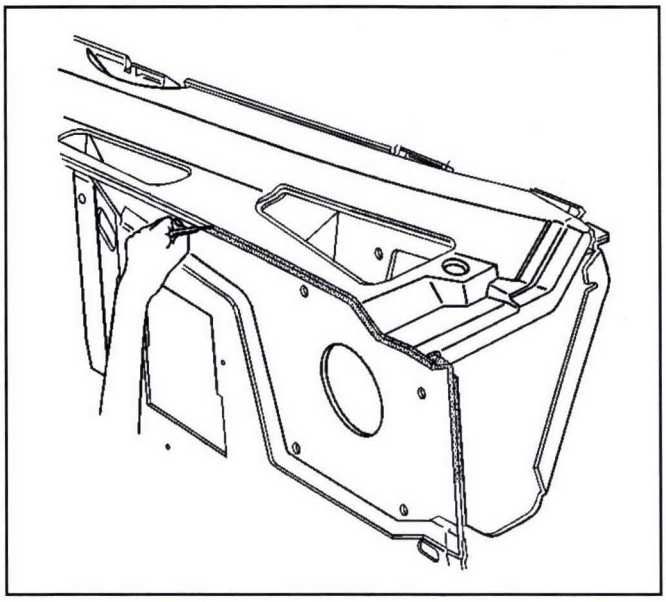
Warning: If the vehicle interior is exposed to moisture and becomes soaked up to the level of the sensing and diagnostic module (SDM), the SDM and SDM harness connector must be replaced. The SDM could be activated when powered, which could cause airbag deployment and result in personal injury.

Depending on the location of the waterleak, you may have to remove certain interior components in order to repair the leak.

1. If the floor carpet is wet, refer to *Floor Carpet Drying on page 2-18*.



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2. Cut out a portion of the adhesive caulking in the leak area from inside or outside of the vehicle.
3. Clean and remove all loose particles of the adhesive old caulking from the area.
4. Apply joint body and seam sealer where the old adhesive caulking was removed.
5. Allow the adhesive caulking to dry for several hours.
6. Test for leaks.
7. Install the trim, if removed.

Stationary Window Waterleak Repair

Warning: If any water enters the vehicle interior up to the level of the carpet or higher and soaks the carpet, the sensing and diagnostic module (SDM) and the SDM harness connector may need to be replaced. The SDM could be activated when powered, which could cause deployment of the air bag(s) and result in personal injury. Before attempting these procedures, the SIR system must be disabled. Refer to Disabling the SIR System.

With the ignition OFF, inspect the SDM mounting area, including the carpet. If any significant soaking or evidence of significant soaking is detected, you must perform the following tasks:

1. ***Remove all water.***
2. ***Repair the water damage.***
3. ***Replace the SDM harness connector.***
4. ***Replace the SDM.***

Failure to follow these tasks could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

1. If the floor carpet is wet refer to *Floor Carpet Drying on page 2-18*.
2. Remove the trim moldings or the headliner in order to repair the leak, if needed.
3. Determine the source of water entry.
4. If water is leaking at the edge of the windshield, reseal the windshield using Urethane Adhesive Caulking Kit GM P/N 12346392 or the equivalent.
5. If water leaks into the vehicle at the sides of the stationary windows, reseal the window using Urethane Adhesive Caulking Kit GM P/N 12346392 or the equivalent.

Section 2

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Exterior Trim

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Radiator Grille Emblem Screws	1.3 N•m	12 lb in
Rear End Spoiler Nuts	5 N•m	44 lb in

Visual Identification

Graphics/Decals/Emblems

Important: The striping material highlights vehicle surface imperfections. Eliminate all of the following before applying the stripe or the decal:

- Dings
- Rough metal
- Paint defects
- Uneven 2-tone paint breaklines

Important: Apply stripes and decals in a clean environment where dust and fibers do not interfere with proper adhesion.

1. Clean the area where you will apply the decal.
   1.1. Use the suitable solvents such as flash naptha, or a 50/50 mixture by volume of isopropyl alcohol and clean drinkable water.
   1.2. Dry the area thoroughly with a clean lint-free cloth.
   1.3. Repaint the area. Feather the paint in, if the paint is chipped.
2. Warm the body surface to 21–38°C (70–100°F).
3. Apply the tape stripe or the decals that wrap into the body openings or mount on flexible surfaces wet.

   Use the following procedure for wet application of stripes and decals:
4. Using a 24 oz. spray bottle add 1–2 drops of unscented dishwashing soap for a wetting agent. If above 80°F you may use 2–3 drops of soap per 24 oz.
5. Spray a mist of solution onto the body area.
6. Peel the backing away from the decal.
7. Spray the adhesive backing of the decal in hot, humid weather with a mist of the wetting solution.
8. Position the decal in the desired location on the body surface.
9. Using a dampened squeegee, starting at the center of the decal, work from the center outward in both directions.
10. Squeegee the decal, in position, onto the body, removing any air bubbles along with the wetting solution.
11. Pull the decal back onto itself in order to remove the premask from the decal.
12. Squeegee the decal again.
13. Prick any air bubbles with a pin, if present. Never use a razor or knife as this may cause the cut to get larger over time.
14. If desired, heat can be applied to the edges of the stripe, decal or emblem to assure adhesion. 3 seconds at 140°F would be satisfactory.

Important: Never use a wetting agent when installing an emblem.

Emblems should always be installed dry.

Repair Instructions

Emblem/Nameplate Replacement

Caution: Refer to *Exterior Trim Emblem Removal Caution on page 0-8*.

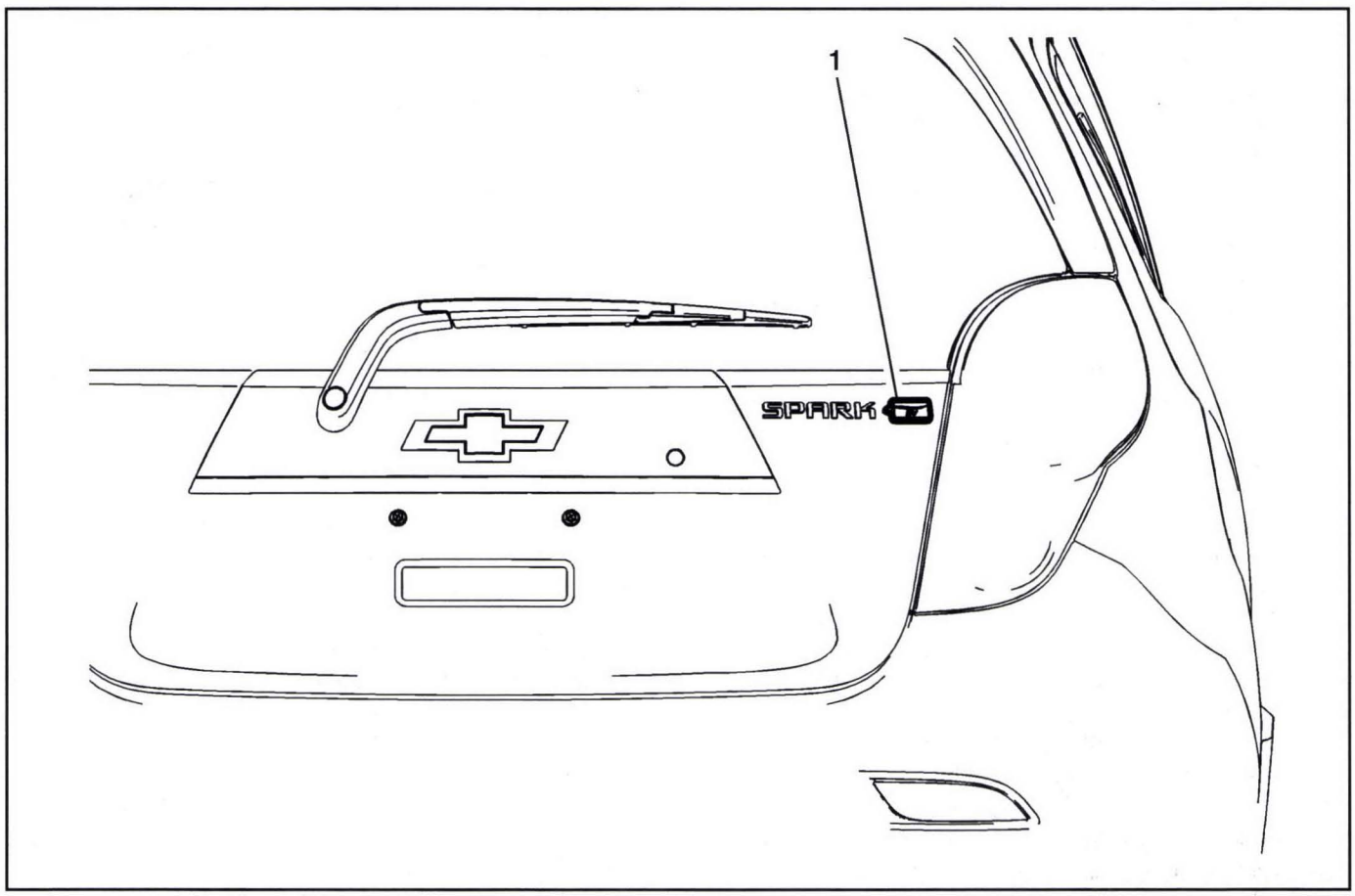
1. The part and vehicle surface should be 21°C (70° F) prior to installation. The vehicle should remain inside in a temperature range of 21°C (70°F) for 1 hour after assembly to allow the adhesive to develop sufficient bond strength.
2. Using masking tape, mark two sides of the placement where the old emblem/nameplate was placed.
3. Use a heat gun or equivalent, to heat the adhesive backed emblem/nameplates.
4. A flat-bladed plastic tool can assist in the removal process.
5. Wipe the vehicle surface area with a 50/50 solution by volume of isopropyl alcohol and clean drinkable water.
6. Dry the area with a clean lint-free cotton cloth.
7. Close any doors, liftgates, endgates and rear compartment lids where emblem/nameplates are to be placed.
8. When removing protective liners from adhesive backed emblem/nameplates, be careful not to touch the adhesive tape or allow the tape to come in contact with dirt or any foreign matter prior to the placement and adhesion.
9. Remove the protective liner from the emblem/ nameplate.
10. Position, align and press the emblem/nameplate to the previously marked location.

11. Using a clean towel and the palm of the hand, press firmly for approximately 30 seconds, the emblem/nameplate to the vehicle body panel surface.
12. Ensure the emblem/nameplate is attached firmly to the body panel surface.
13. Remove the masking tape and clean all tape residue from the vehicle body panel surface around the emblem/nameplate attachment location.

Body Panel Paint Protector Replacement

1. The paint protective film and vehicle surface temperature should be 13–32°C (55–90°F) for best results.
2. Automatic car washes should be avoided for at least 24 hours after the paint protective film application.
3. Wipe the vehicle surface with isopropyl alcohol or flash naptha at the application area.
4. Dry the surface with a clean lint-free cloth.
5. Create a mixture of 25 percent isopropyl alcohol and 75 percent water and two drops of baby shampoo per 16 oz of fluid mixture.
6. Remove the backing liner from the protective film patch.
7. Use the solution to liberally spray the adhesive side of the protective patch, the mounting location along with your hands.
8. Position the paint protective film patch to the desired location on the vehicle.
9. Spray the surface of the film with the alcohol, water and soap solution.
10. Using a dampened squeegee, start at the center of the protective patch, working outward in order to remove the air and solution from under the protective patch.
11. Release any air bubbles with a pin.
12. Dry the surface with a clean, lint-free cotton cloth.

Liftgate Emblem/Nameplate Replacement



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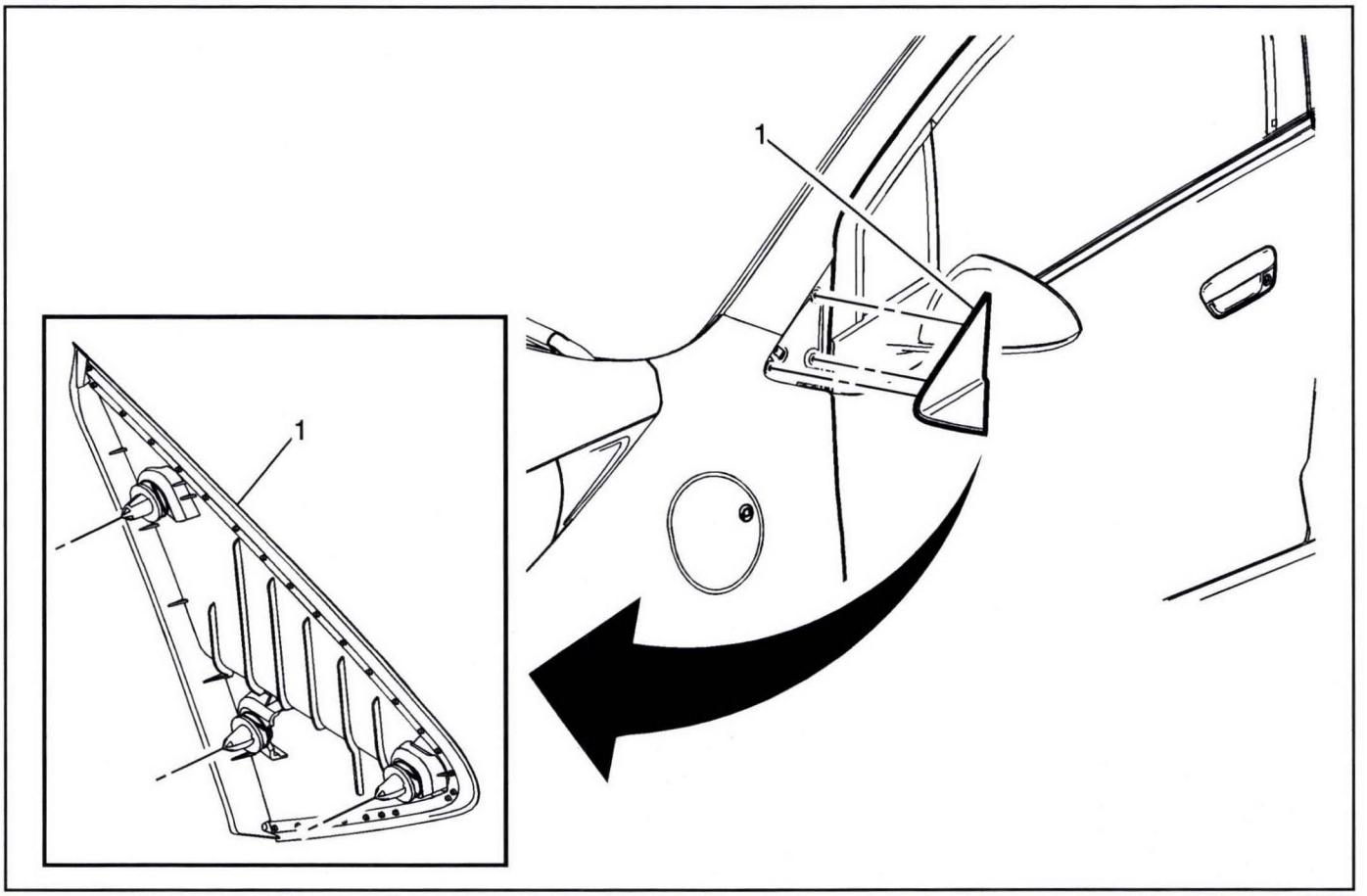
Liftgate Emblem/Nameplate Replacement

Callout	Component Name
1	Liftgate Emblem/Namplate **Caution:** Refer to *Exterior Trim Emblem Removal Caution on page 0-8.* **Procedure** 1. The part and surface should be 21°C (70°F) prior to installation. The vehicle should remain 21°C (70°F) for one hour after assembly to allow adhesive to develop sufficient bond strength. 2. Apply a suitable tape around the liftgate emblem/nameplate. 3. Use a heat gun or equivalent to remove. Use a suitable flat bladed tool to assist in the removal. 4. Clean any remaining residue with a 50/50 mixture by volume of isopropyl alcohol and clean drinkable water. Wipe surface dry with a clean lint-free towel. 5. When removing protective liners from adhesive backing, be careful not to touch the tape with hands and do not allow the tape to come in contact with dirt or any foreign matter prior to adhesion. 6. Using the palm of the hand wet out the emblem/nameplate to the liftgate to ensure full adhesion is made.

Body Side Upper Front Applique Replacement



2969574

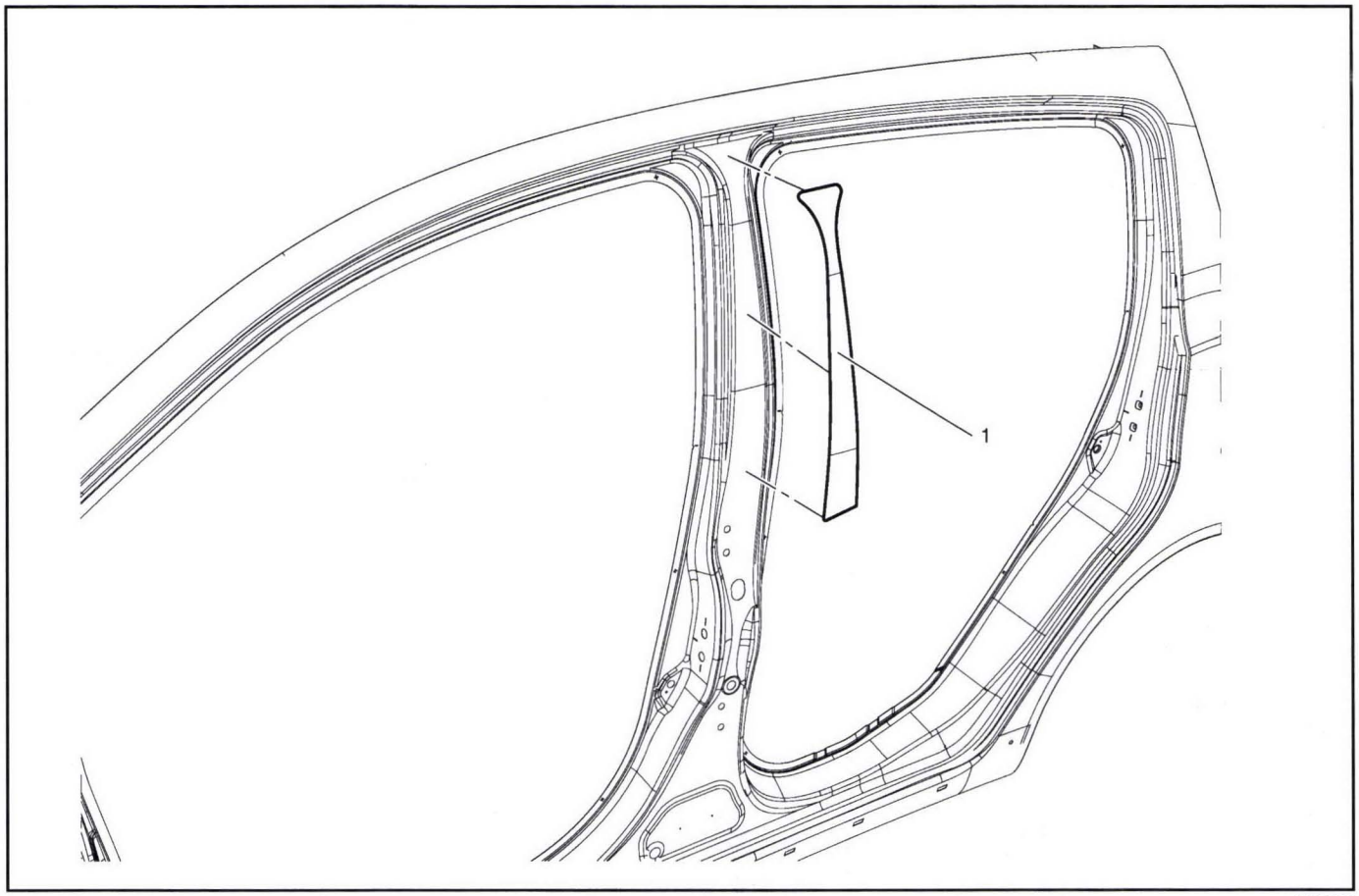
Body Side Upper Front Applique Replacement

Callout	Component Name
Caution: Refer to *Exterior Trim Emblem Removal Caution on page 0-8.* **Preliminary Procedure** Apply a suitable tape around the front edge of the body side upper front applique to protect the paint.	
1	Body Side Upper Front Applique

Body Side Upper Front Applique Replacement (cont'd)

Callout	Component Name
	Procedure 1. Using a trim type release tool, disengage the forward clip from the body side outer panel. 2. Gently pull the body side upper front applique away from the vehicle to disengage the 2 remaining clips. 3. Upon installation, using the palm of the hand secure each retainer location until fully seated to the body side outer panel and front fender.

Center Pillar Applique Replacement



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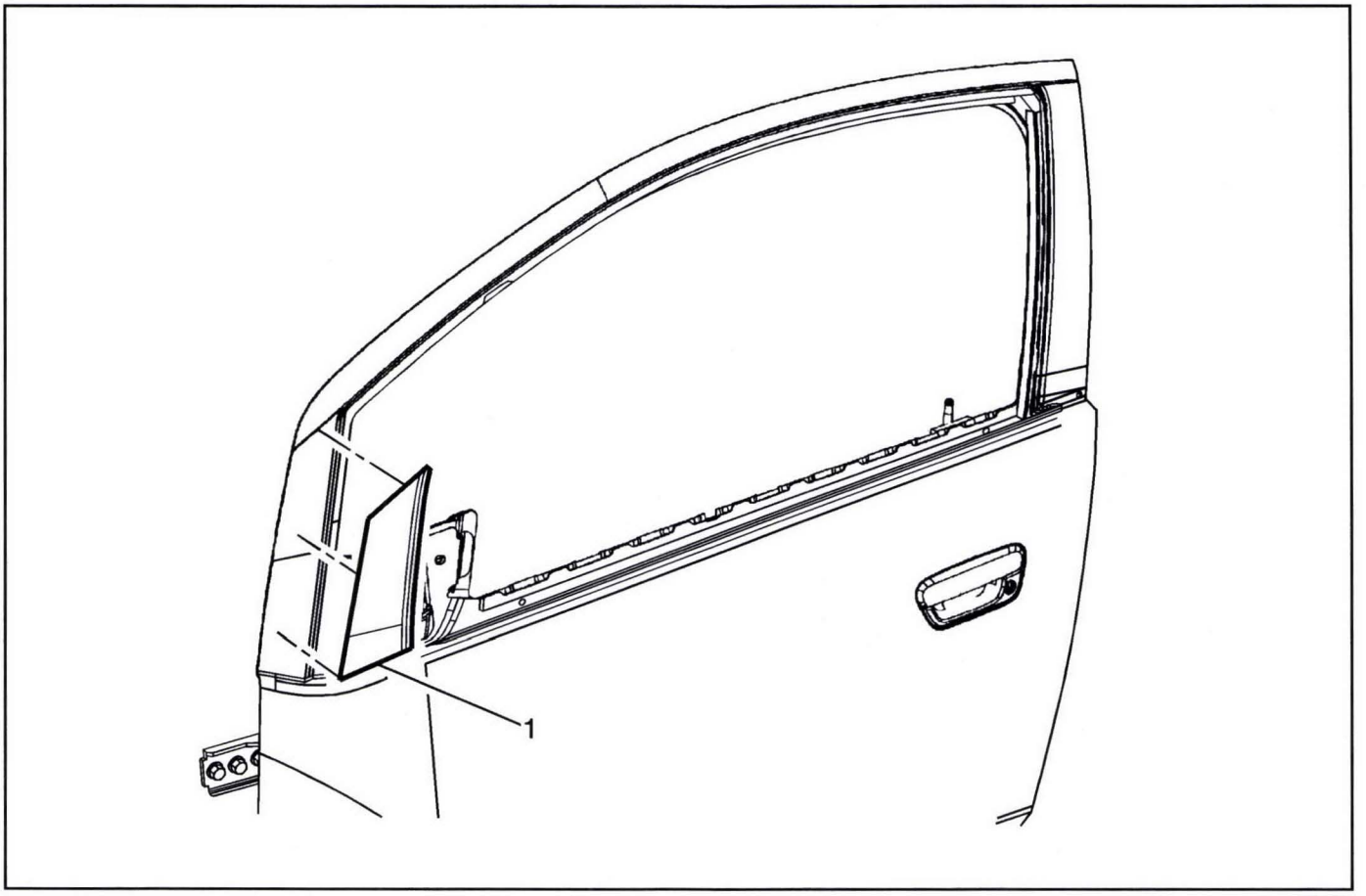
Center Pillar Applique Replacement

Callout	Component Name
Preliminary Procedure Open the front and rear side doors.	
1	Center Pillar Applique **Procedure** 1. Fit the tape pre-mask line to the panel character line. 2. Peel off the inside paper. 3. Attach the tape to the door panel. 4. Press the tape by using the squeegee or equivalent. 5. Peel off the outside paper. 6. Inspect the tape is properly attached. **Note:** This applique is an adhesive tape.

Front Side Door Window Frame Front Applique Replacement



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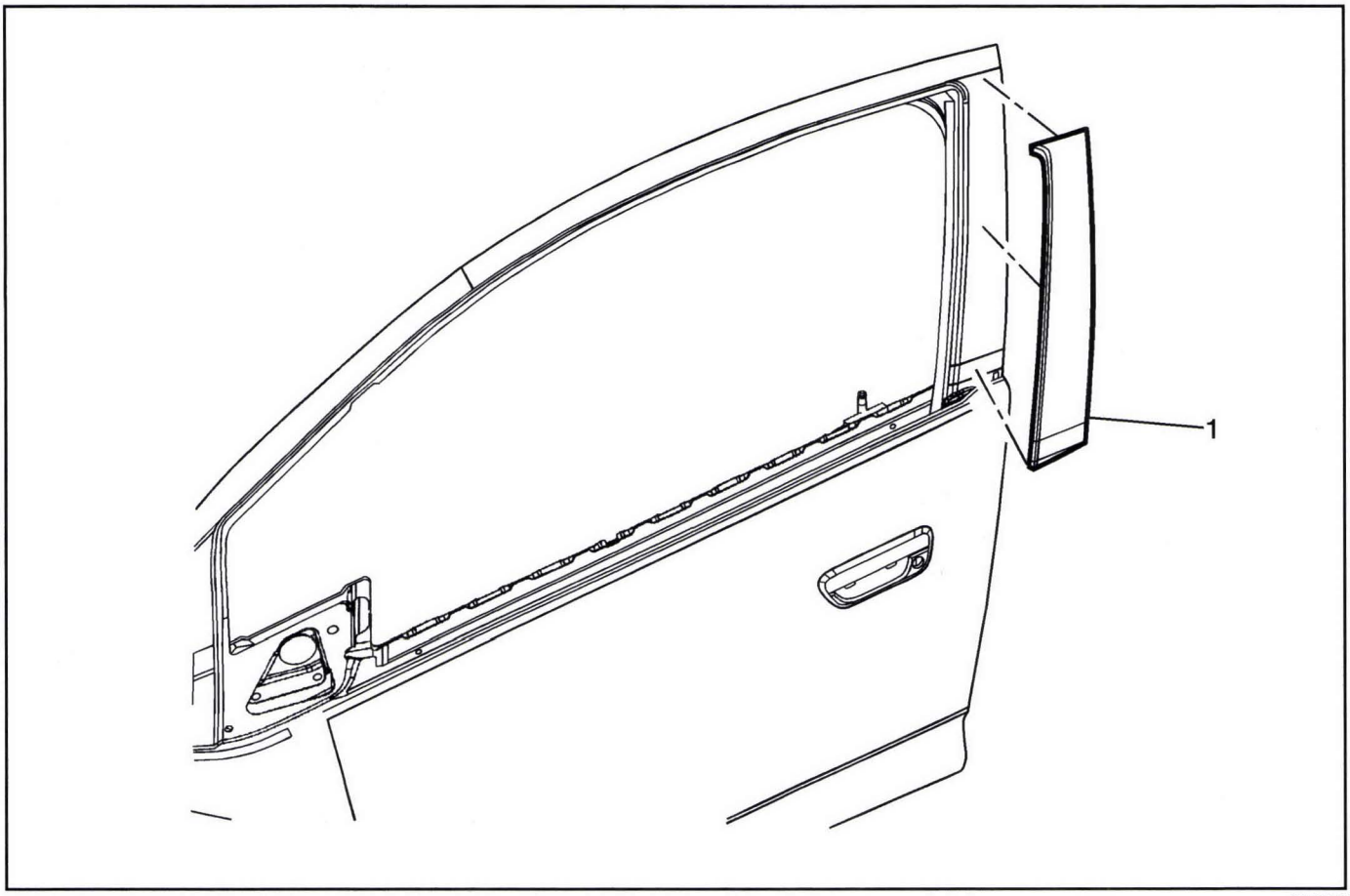
Front Side Door Window Frame Front Applique Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the outside mirror. Refer to *Outside Rearview Mirror Replacement on page 4-209*. 2. Remove the front side door stationary window. Refer to *Front Side Door Stationary Window Replacement on page 4-39*.	
1	Front Side Door Window Frame Front Applique **Procedures** 1. Fit the tape pre-mask line to the panel character line. 2. Peel off the inside paper. 3. Attach the tape to the door panel. 4. Press the tape by using a squeegee or equivalent. 5. Peel off the outside paper. 6. Wrap the corner areas of the tape. 7. Inspect the tape is properly attached. **Note:** This applique is an adhesive tape.

Front Side Door Window Frame Rear Applique Replacement



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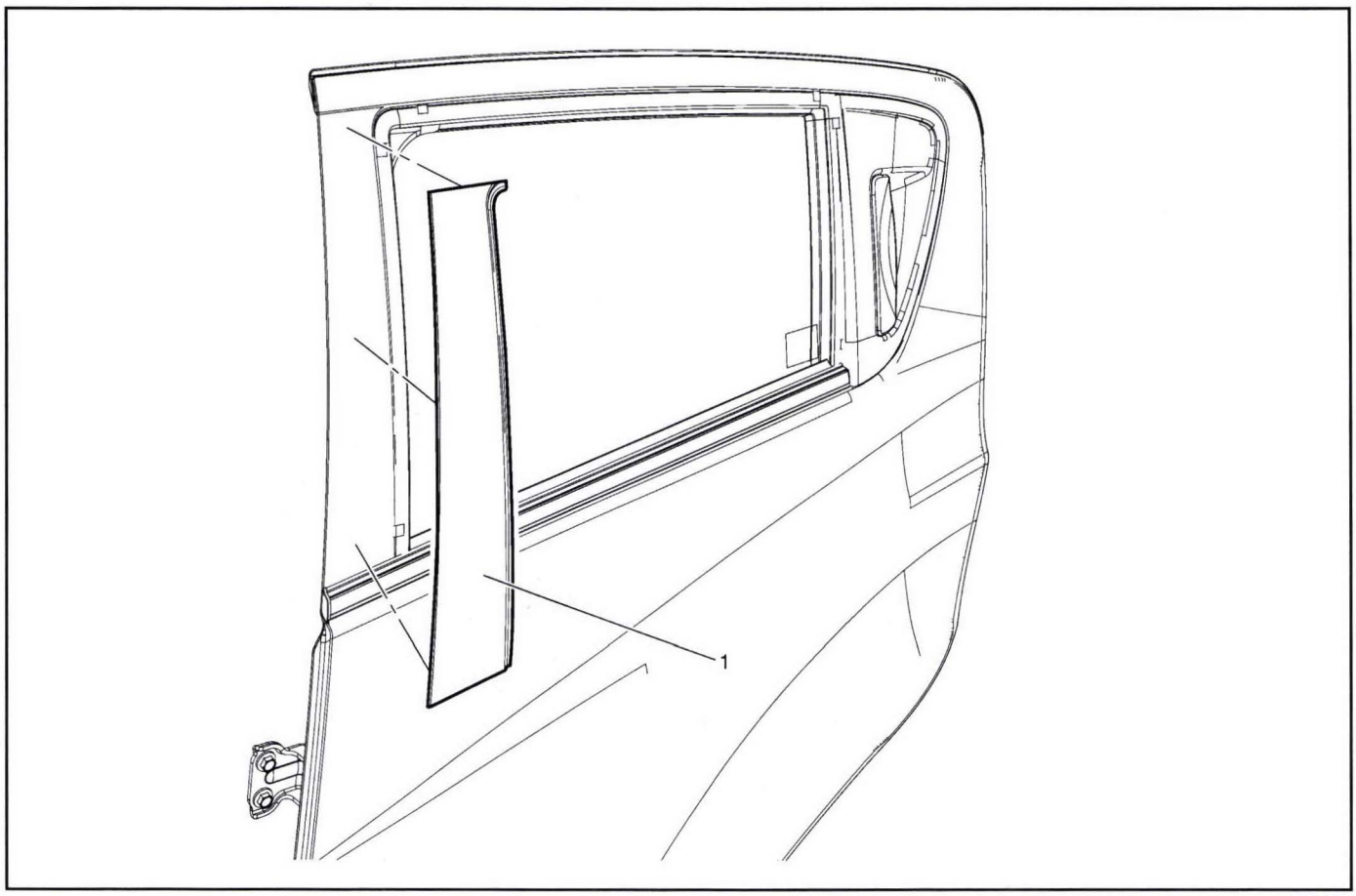
Front Side Door Window Frame Rear Applique Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the front side door window outer sealing strip. Refer to *Front Side Door Window Outer Sealing Strip Replacement on page 4-45*. **Note:** Do not need to remove the weatherstrip assembly. Just partially peel off the weatherstrip to attach the tape. 2. Grasp upper corner of the window weatherstrip, pull downward releasing the assembly from the door frame.	
1	Front Side Door Window Frame Rear Applique **Procedures** 1. Fit the tape pre-mask line to the panel character line. 2. Peel off the inside paper. 3. Attach the tape to the door panel. 4. Press the tape by using a squeegee or equivalent. 5. Peel off the outside paper. 6. Wrap the corner areas of the tape. 7. Inspect the tape is properly attached. **Note:** This applique is an adhesive tape.

Rear Side Door Window Frame Front Applique Tape Replacement



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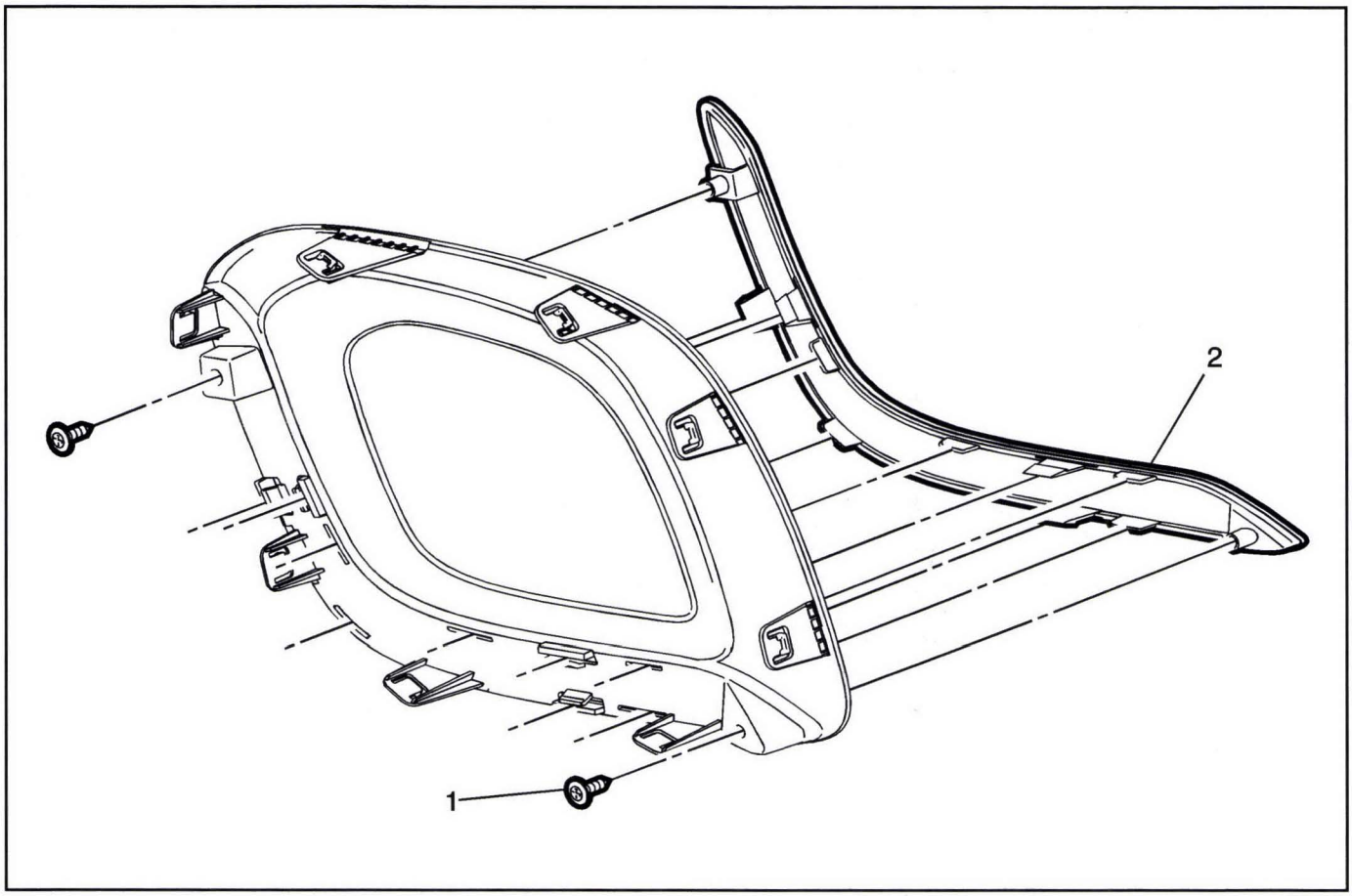
Rear Side Door Window Frame Front Applique Tape Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the rear side door window outer sealing strip. Refer to *Rear Side Door Window Outer Sealing Strip Replacement on page 4-48*. 2. Grasp upper corner of the window weatherstrip, pull downward releasing the assembly from the door frame. **Note:** Do not need to remove the weatherstrip assembly. Just partially peel off the weatherstrip to attach the tape.	
1	Rear Side Door Window Frame Front Applique **Procedure** 1. Fit the tape pre-mask line to the panel character line. 2. Peel off the inside paper. 3. Attach the tape to the door panel. 4. Press the tape by using a squeegee or equivalent. 5. Peel off the outside paper. 6. Wrap the corner areas of the tape. 7. Inspect the tape is properly attached. **Note:** This applique is an adhesive tape.

Front Bumper Impact Bar Fog Lamp Access Hole Cover Replacement



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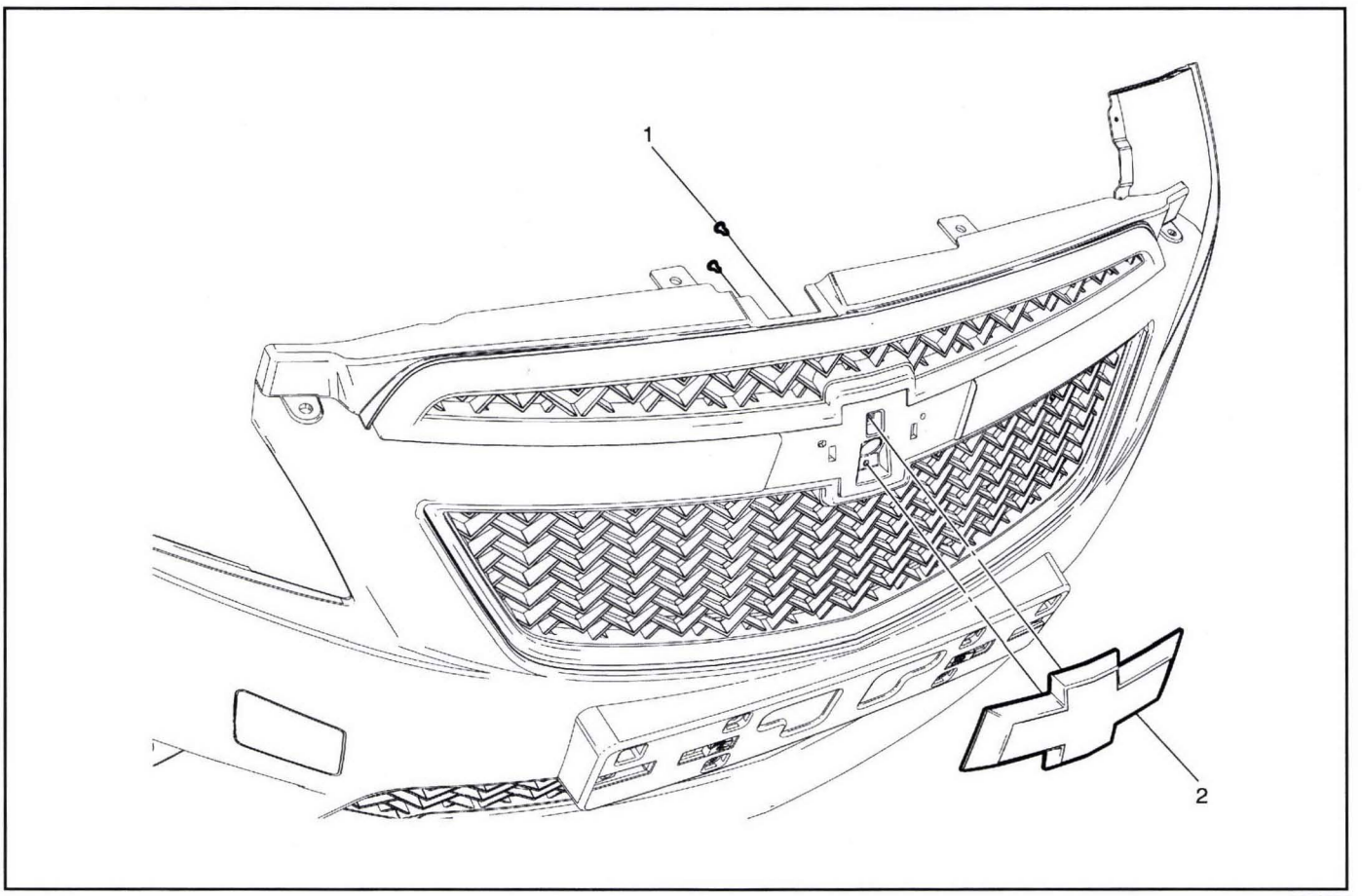
Front Bumper Impact Bar Fog Lamp Access Hole Cover Replacement

Callout	Component Name
Preliminary Procedure Remove the front bumper fascia opening cover. Refer to *Front Bumper Fascia Opening Cover Replacement (Center) on page 3-61*.	
1	Front Bumper Impact Bar Fog Lamp Access Hole Cover Screw (Qty: 2) **Caution::** Refer to *Fastener Caution on page 0-8*.
2	Front Bumper Impact Bar Fog Lamp Access Hole Cover **Procedure** With a flat bladed tool release the 4 locking tabs and pull front bumper impact bar fog lamp access hole cover forward.

Front Bumper Fascia Emblem/Nameplate Replacement



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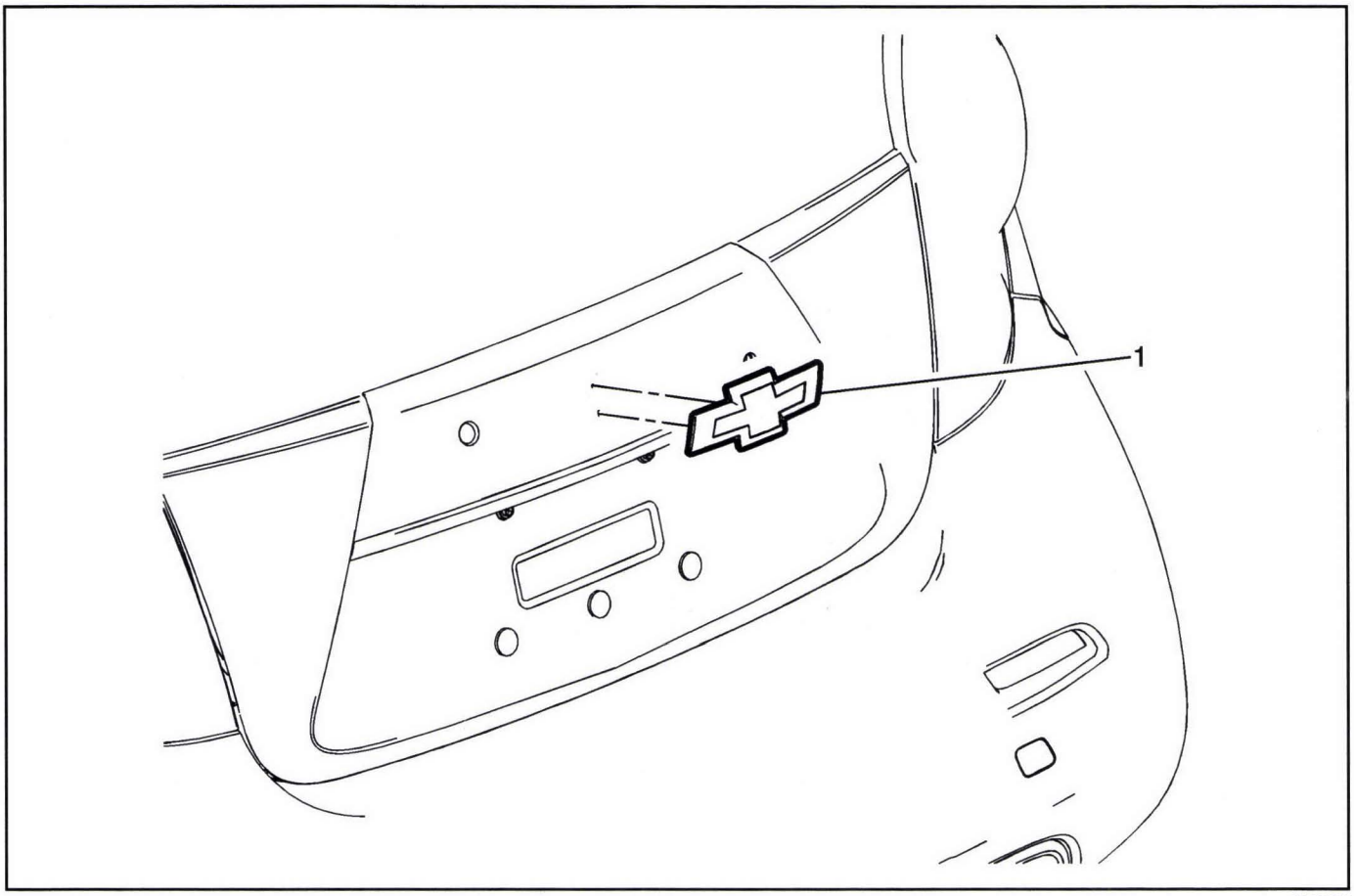
Front Bumper Fascia Emblem/Nameplate Replacement

Callout	Component Name
Preliminary Procedure Remove the front bumper fascia. Refer to *Front Bumper Fascia Replacement on page 3-57*.	
1	Radiator Grille Emblem Screw (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 2.5 N•m (23 lb in)
2	Radiator Grille Emblem Assembly

Liftgate Outside Handle Emblem Replacement



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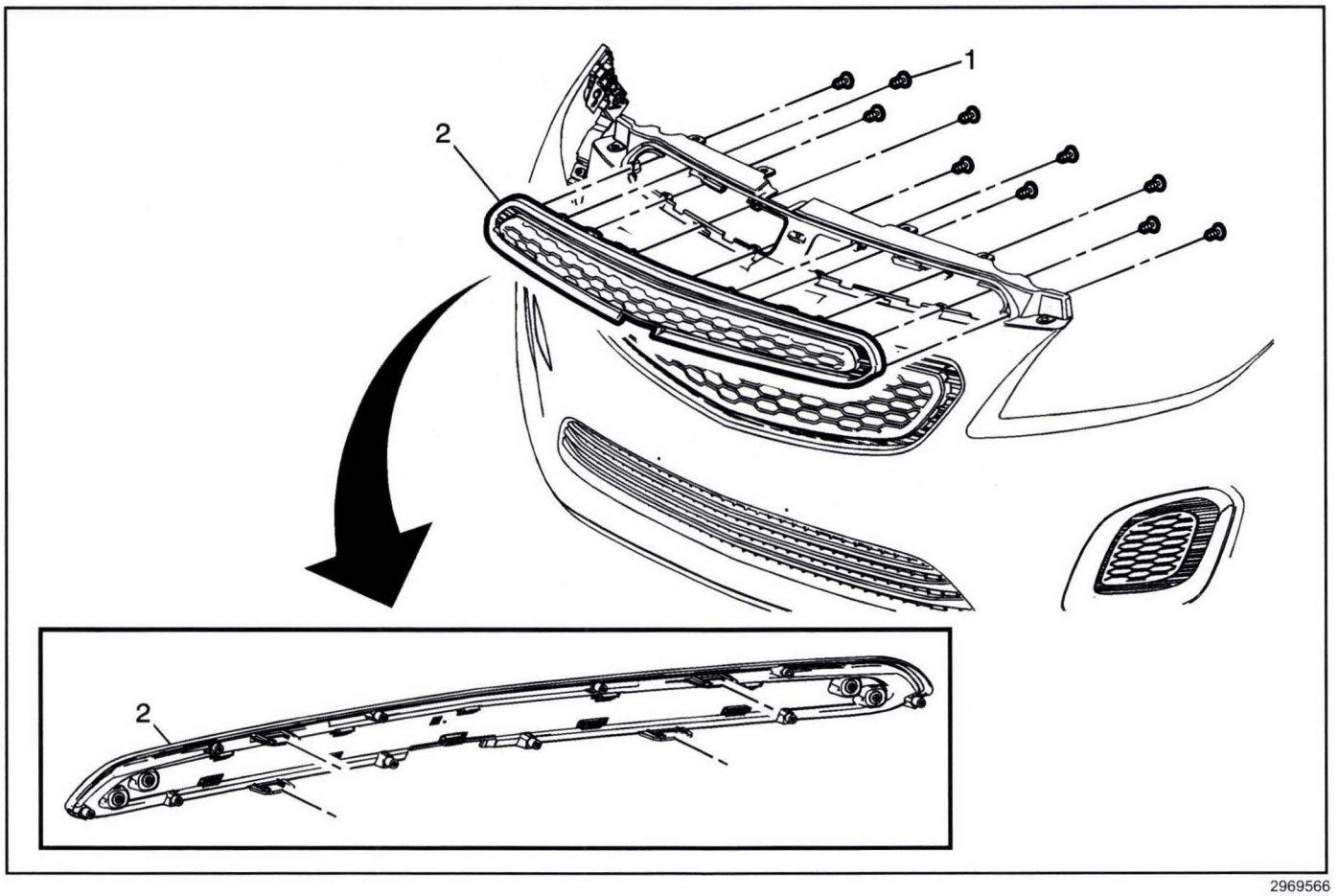
Liftgate Outside Handle Emblem Replacement

Callout	Component Name
1	Liftgate Emblem/Namplate **Caution:** Refer to *Exterior Trim Emblem Removal Caution on page 0-8*. **Procedure** 1. The part and surface should be 21°C (70°F) prior to installation. The vehicle should remain 21°C (70°F) for one hour after assembly to allow adhesive to develop sufficient bond strength. 2. Apply a suitable tape around the liftgate outside handle emblem. 3. Use a heat gun or equivalent to prep for removal. 4. Use a suitable flat bladed tool to assist in the removal. 5. Clean any remaining residue with a 50/50 mixture by volume of isopropyl alcohol and clean drinkable water. Wipe surface dry with a clean lint-free towel. 6. When removing protective liners from adhesive backing, be careful not to touch the tape with hands and do not allow the tape to come in contact with dirt or any foreign matter prior to adhesion. 7. Align the liftgate outside handle emblem locating tabs with the holes on the liftgate applique and using the palm of the hand press evenly to ensure full adhesion is made.

Front Upper Grille Replacement



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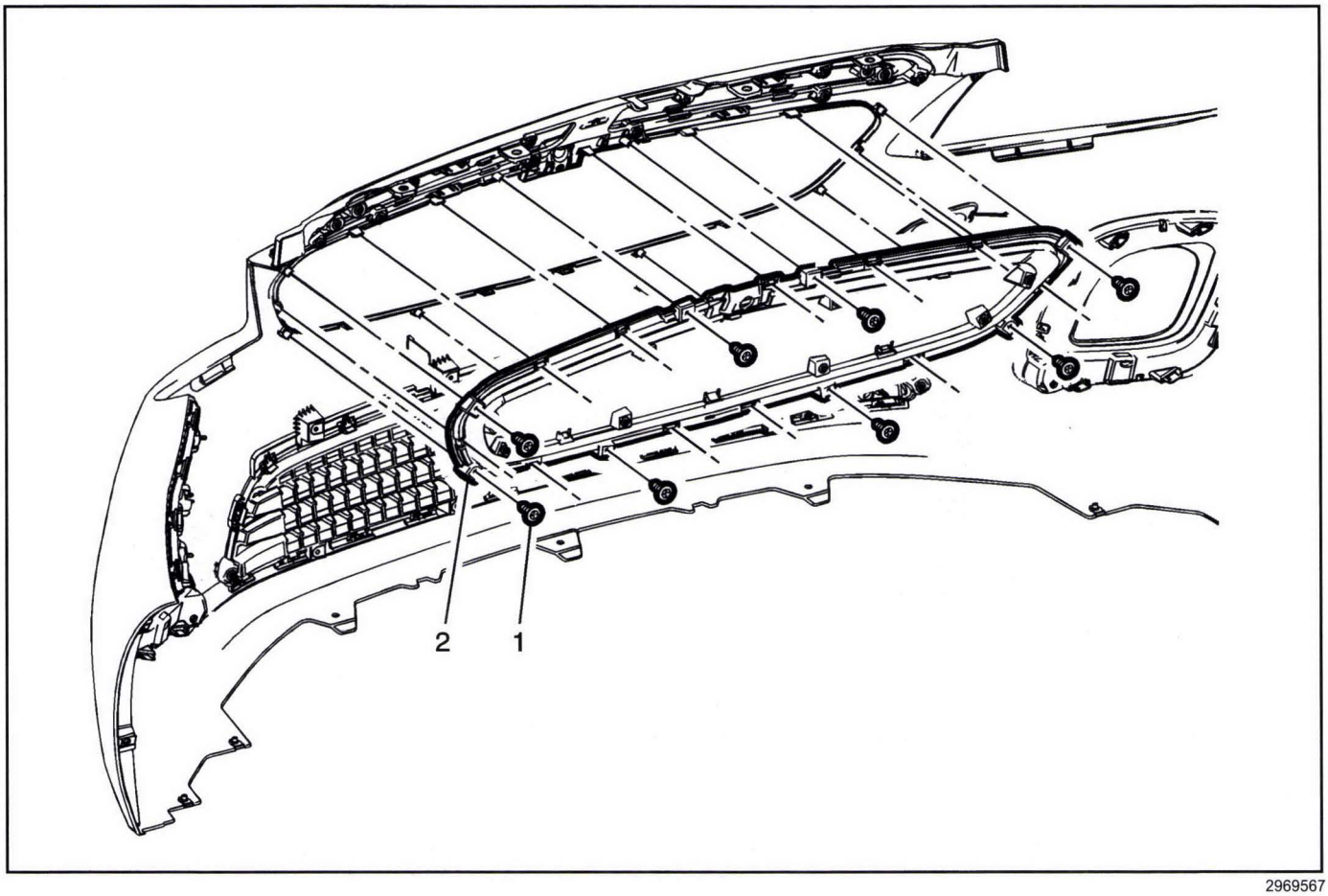
Front Upper Grille Replacement

Callout	Component Name
Preliminary Procedure Remove the front bumper fascia. Refer to *Front Bumper Fascia Replacement on page 3-57*.	
1	Radiator Upper Grille Screw (Qty: 10) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Radiator Upper Grille **Procedure** Release the 4 locking tabs and pull the radiator upper grille forward from the front bumper fascia.

Front Lower Grille Replacement



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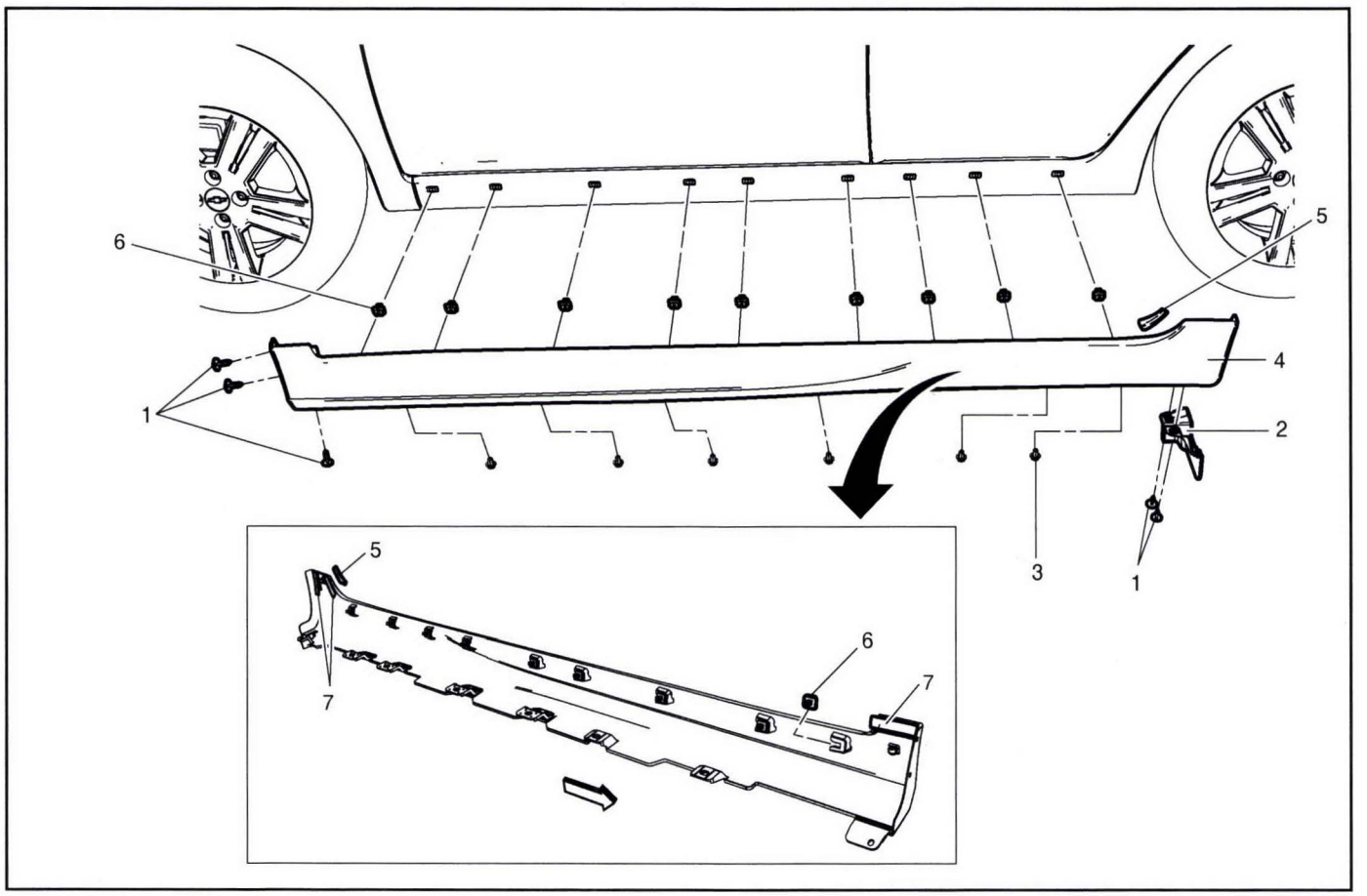
Front Lower Grille Replacement

Callout	Component Name
Preliminary Procedure Remove the front bumper fascia. Refer to *Front Bumper Fascia Replacement on page 3-57*.	
1	Front Lower Grille Screw (Qty: 8) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Radiator Upper Grille **Procedure** Release the 11 locking tabs and pull the front lower grille rearward from the front bumper fascia.

Rocker Panel Molding Replacement



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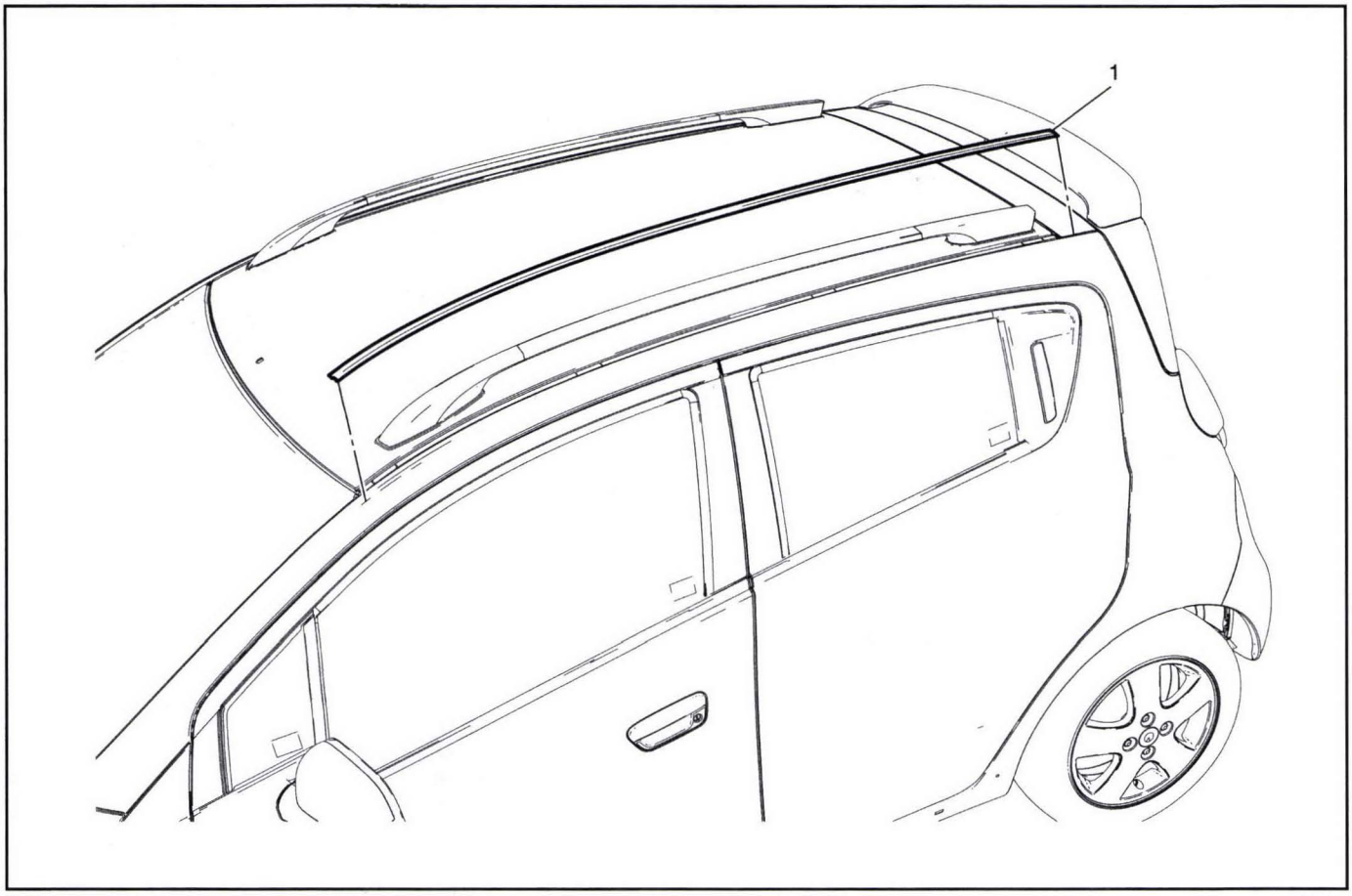
Rocker Panel Molding Replacement

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*. 2. Remove the wheel and wheel assemblies. Refer to *Tire and Wheel Removal and Installation on page 15-51*.	
1	Rocker Panel Molding Screw (Qty: 5) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 1.5 N•m (13 lb in)
2	Rear Wheelhouse Extension
3	Rocker Panel Molding Retaining Clip (Qty: 6)
4	Rocker Panel Molding
5	Front Rocker Panel Molding Protect Film **Note:** When installing new parts, attach the protect film to molding.
6	Front Rocker Panel Molding Inside Clip (Qty: 9)
7	Front Rocker Panel Molding Double-Sided Adhesive Tape (Qty: 3) **Note:** When installing new parts, attach the double-sided adhesive tape to molding.

Roof Panel Joint Finish Molding Replacement



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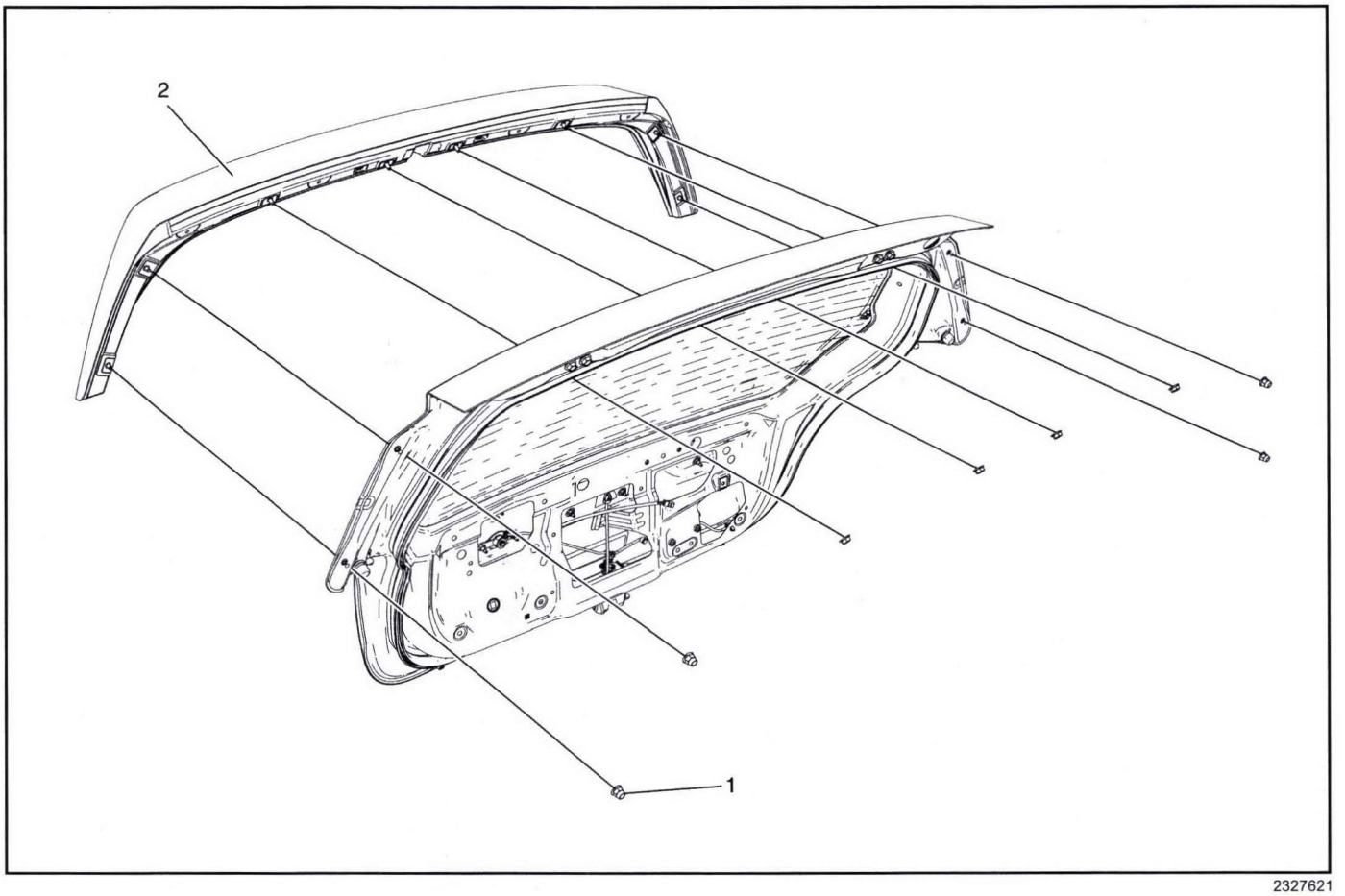
Roof Panel Joint Finish Molding Replacement

Callout	Component Name
Preliminary Procedure Begin at the rear window and lift the molding from the ditch, disengaging the molding from the four integral ditch retaining clips.	
1	Roof Panel Joint Finish Molding Assembly **Procedure** 1. Begin at the front windshield, tuck the finish molding tab to the front roof header. 2. Using a roller-type tool, roll the ditch molding into the ditch securing the molding to each of the four integral ditch retainers. 3. Inspect the levelness of the ditch molding to the roof panel. 4. If not level, roll the area again to achieve a smooth fit to the ditch.

Rear End Spoiler Replacement



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Rear End Spoiler Replacement

Callout	Component Name
Preliminary Procedures 1. Open the liftgate. 2. Detach the nut cover tape.	
1	Rear End Spoiler Nut (Qty: 8) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 5 N•m (44 lb in)
2	Rear End Spoiler **Note:** If the stop lamp is equipped, disconnect the center high mount stop lamp wiring harness before removing the rear end spoiler.

Floor Coverings and Headlinings

Specifications

Adhesives, Fluids, Lubricants, and Sealers

Application	Type of Material	GM Part Number
GM Vehicle Care Odor Eliminator	Fluids	Refer to Electronic Parts Catalog.

Repair Instructions

Eliminating Unwanted Odors in Vehicles

GM Vehicle Care Odor Eliminator, Refer to *Adhesives, Fluids, Lubricants, and Sealers on page 2-18* , may control or eliminate odors in the interior and luggage compartment areas of GM vehicles. This non-toxic, biodegradable, odorless product has been shown to greatly reduce or remove the following types of odor:

- Objectionable smells of mold and mildew resulting from vehicle water leaks
- Customer created odors, such as smoke

You may safely use GM Vehicle Care Odor Eliminator on fabrics, vinyl, leather, carpet, and sound deadening materials. You may also induce this product into HVAC modules and instrument panel ducts for the control of non-bacterial related odors.

Note: This product leaves no residual scent and should not be used as an air freshener.

This product may result in the permanent elimination of an odor and may be preferable to customers whose allergies make them sensitive to perfumes. This product may effectively remove odors when directly contacting the odor source. In cases such as water leaks, use this product with diagnostic procedures to first eliminate the primary cause of the odor. Then use further applications on the residual odor to permanently correct the vehicle condition.

How to Use this Product

- Spray GM Vehicle Care Odor Eliminator directly or as an additive with carpet shampoo in steam cleaners.
- Do not use on any interior surface that plain water would deteriorate, because this product will have the same effect. Also avoid letting this product come into contact with vinegar or any acidic substance. Acid-based products will hamper the effectiveness of GM Vehicle Care Odor Eliminator.
- Complete eight page treatment sheets are enclosed within each case of GM Vehicle Care Odor Eliminator. These treatment instructions range from simple vehicle odor elimination to full step by step procedures for odor removal from water leaks.
- Instructions and cautions are printed on the bottle, but additional help is available. If you encounter a persistent or recurring odor, you may call to obtain additional information and usage suggestions.

Floor Carpet Drying

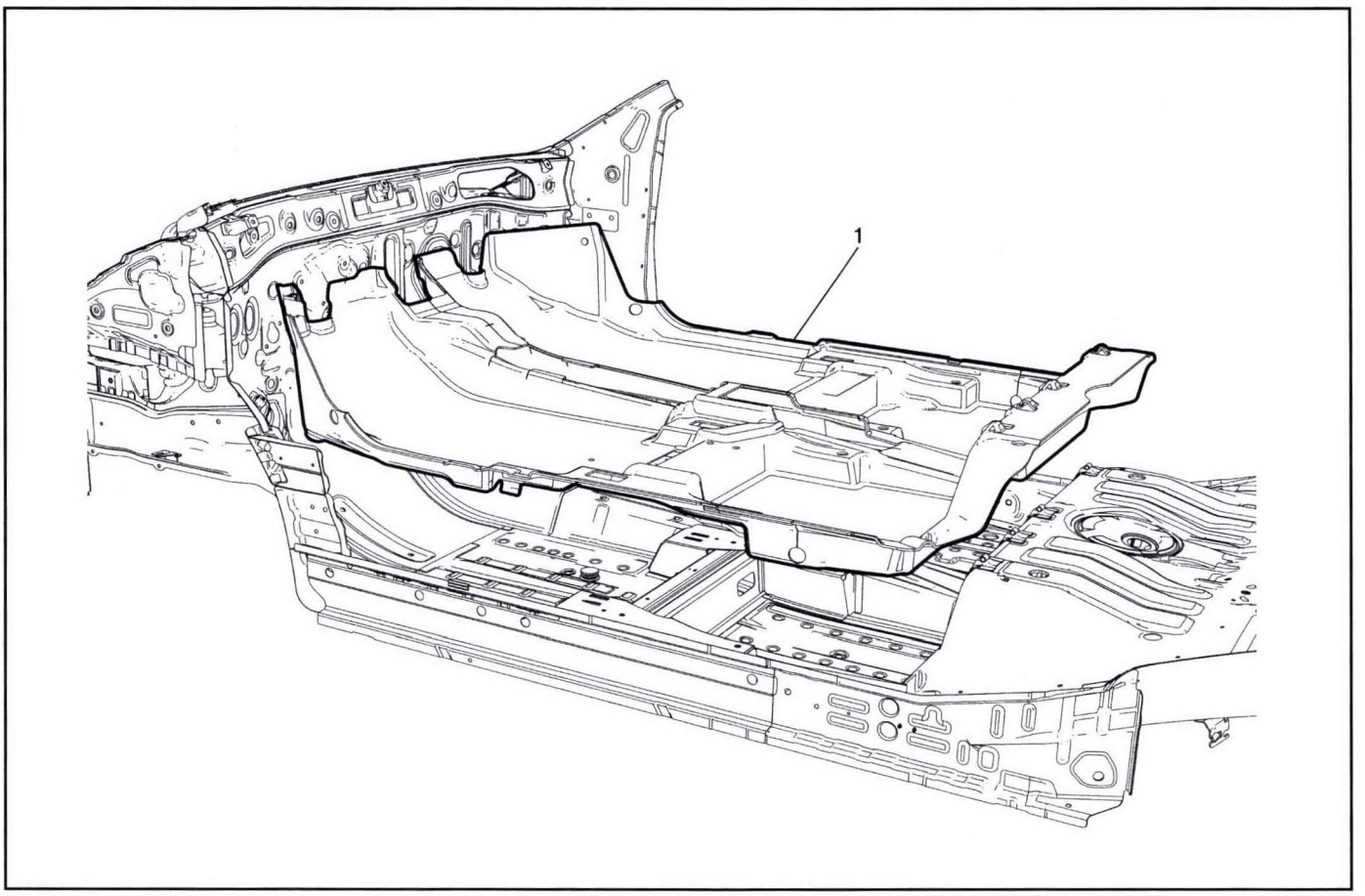
If the carpet or the pad or insulator is wet, use the following criteria for drying or for replacing the components:

- For a 1-piece carpet assembly bonded to a cotton or a fiber padding, replace the entire assembly.
- For a 2-piece carpet assembly with a cotton or a fiber padding, replace the padding only. While the carpet is out of the vehicle, dry the carpet using the method described below.
- For a 1-piece carpet assembly bonded to a foam padding or attached to a synthetic padding, dry the carpet using the method described below.
- For a 2-piece carpet assembly with a synthetic padding, dry the assembly using the method described below.

Drying Method

1. If you observe puddles of liquid on the carpet face, use a wet vacuum to remove the excess moisture.
2. Blot the face of the carpet with a towel in order to absorb as much moisture as possible.
3. Point a fan at the affected area and air dry the carpet.

Floor Panel Carpet Replacement



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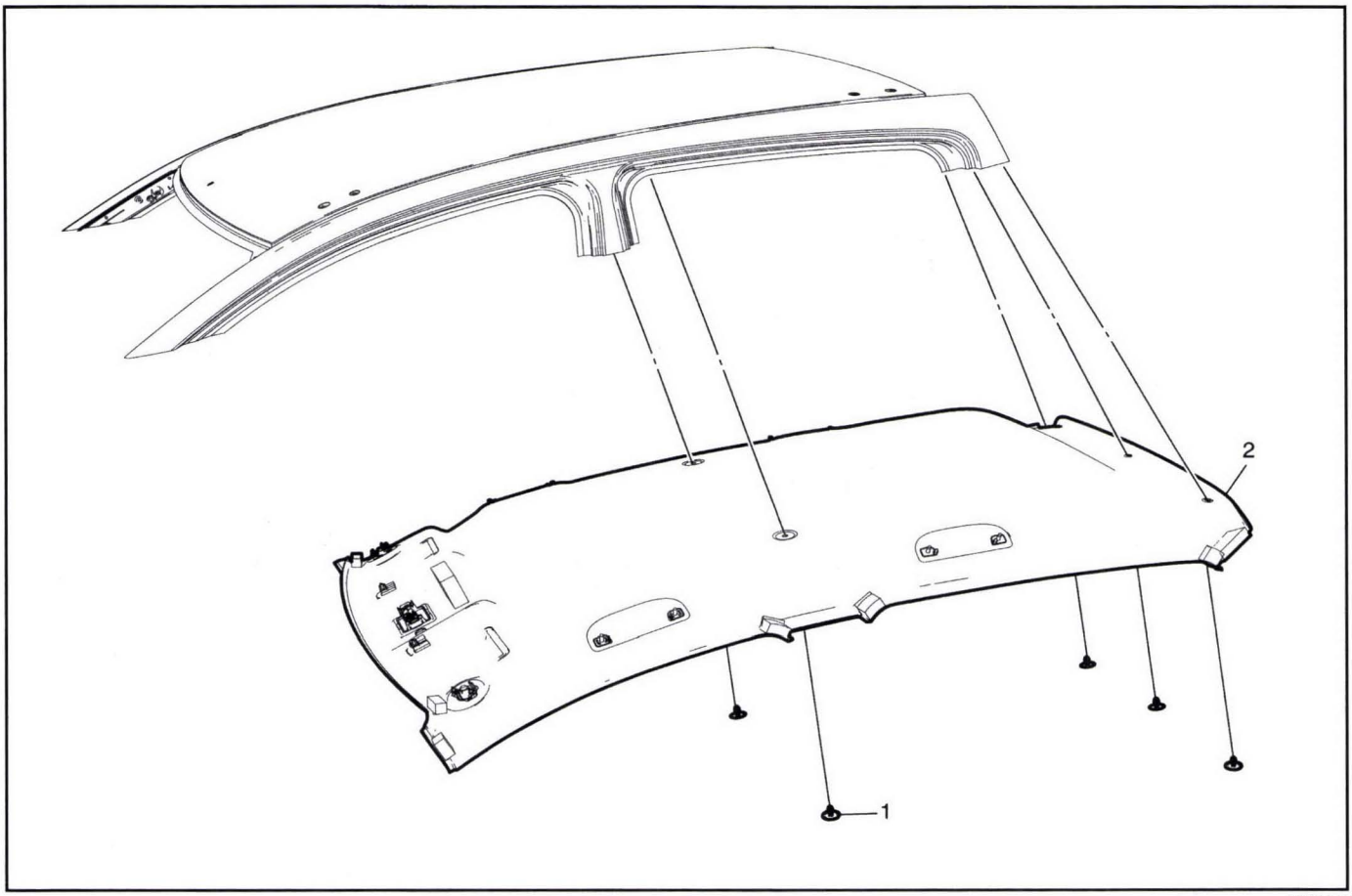
Floor Panel Carpet Replacement

Callout	Component Name
Preliminary Procedures 1. Remove front seats. Refer to *Driver or Passenger Seat Removal and Installation on page 13-3*. 2. Remove rear seat cushion. Refer to *Rear Seat Cushion Removal and Installation on page 13-21*. 3. Remove the front floor console. Refer to *Front Floor Console Replacement on page 2-48*. 4. Remove the front side door sill garnish molding. Refer to *Front Side Door Sill Garnish Molding Replacement on page 2-57*. 5. Remove the rear side door sill garnish molding. Refer to *Rear Side Door Sill Garnish Molding Replacement on page 2-58*. 6. Remove the center pillar lower trim panels. Refer to *Center Pillar Lower Trim Panel Replacement on page 2-63*.	
1	Front Floor Panel Carpet Assembly **Procedure** Loosen the transmission control.

Headlining Trim Panel Replacement



2309213

Headlining Trim Panel Replacement

Callout	Component Name

Warning: Do not attempt to repair or alter the head impact energy-absorbing material glued to the headliner or to the garnish trims. If the material is damaged, replace the headliner and/or the garnish trim. Failure to do so could result in personal injury.

Caution: If a vehicle is equipped with a head curtain inflator module ensure that the inflator module and tether are undamaged. If tether or curtain airbag are damaged in any way, they must be replaced.

Caution: Use care when working around the head curtain inflator module. Sharp tools may puncture the curtain airbag. If the head curtain inflator module is damaged in any way, it must be replaced.

Preliminary Procedures

1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Remove the sunshade. Refer to *Sunshade Replacement on page 2-60*.
3. Remove the assist handles. Refer to *Assist Handle Replacement on page 2-59*.
4. Remove the windshield garnish moldings. Refer to *Windshield Garnish Molding Replacement on page 2-61*.
5. Remove the center pillar upper trim panels. Refer to *Center Pillar Upper Trim Panel Replacement on page 2-62*.
6. Remove the quarter window trim finish panel. Refer to *Quarter Window Trim Finish Panel Replacement on page 2-64*.
7. Remove the center courtesy lamp. Refer to *Center Courtesy Lamp Replacement (North America) on page 4-174* or *Center Courtesy Lamp Replacement (Europe, Korea) on page 4-175*.
8. Move the front seat fully forward and recline.

Headlining Trim Panel Replacement (cont'd)

Callout	Component Name
1	Headliner Trim Panel Retainer (Qty: 5)
2	Headliner Trim Panel Assembly **Procedure** 1. Prior to removal, note routing of wire harness to aid in assembly and to ensure proper installation. 2. Disconnect the electrical connectors. 3. If replacing the headliner assembly, transfer all necessary components. 4. If transferring or replacing the wiring harness, refer to *Headliner Harness Replacement on page 2-21*. **Note:** When installing a new headliner, tape any unused connector to the headliner with a high adhesive tape.

Headliner Harness Replacement

Removal Procedure

1. Remove the headlining trim panel. Refer to *Headlining Trim Panel Replacement on page 2-20*.
2. Take note of the wiring harness locations and measure the harness lead length prior to removing. Mark harness routing locations on new headliner prior to harness removal.

   Note: Use a camera to take pictures and use a pencil to mark the new headliner.
3. Use fiber or plastic trim tool to assist in removing the wiring harness from the headliner, taking care not to damage the harness.
4. Remove excess glue and material from the wiring harness and re-tape areas where the tape was removed or damaged.

Installation Procedure

1. Lay the wiring harness on the new headliner assembly to confirm correct routing and ensure harness leads are proper length for mating connections prior to gluing.

Warning: Do not change the wiring harness routing locations. Correct harness routing is critical for air bag deployment. Possible personal injury or vehicle damage could result if the harness routing is changed.

   Note: When installing a new headliner harness, tape any unused connector to the headliner with a high adhesive tape.

2. Use hot melt adhesive to install the wiring harness. Apply insulator tape over glued locations to prevent squeaks and rattles as needed.
3. Install the headlining trim panel. Refer to *Headlining Trim Panel Replacement on page 2-20*.

Instrument Panel and Console Trim

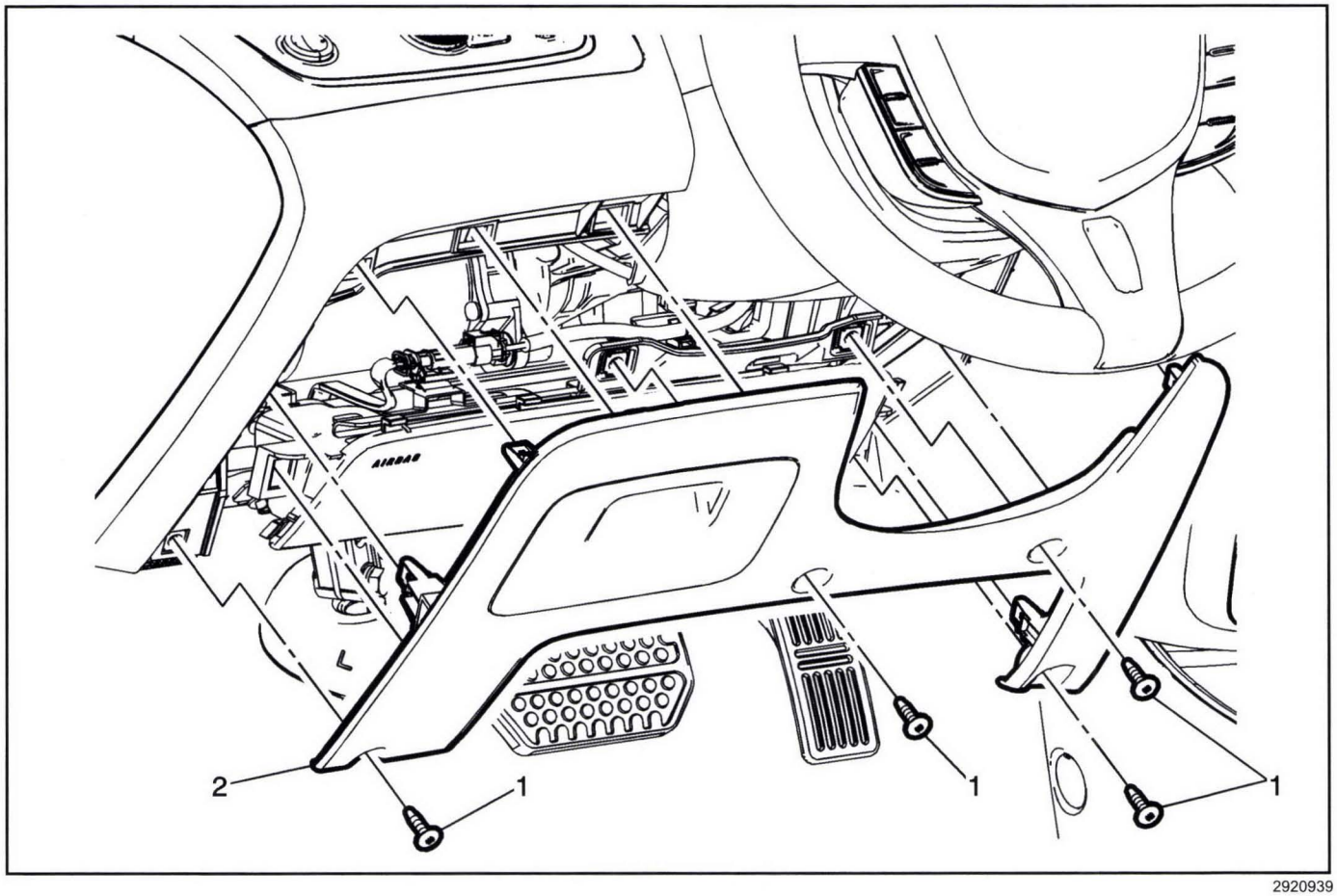
Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Heater and Air Conditioning Evaporator and Blower Module Fastener	6 N•m	53 lb in
Instrument Panel Fastener	22 N•m	16 lb ft
Instrument Panel Center Support Bracket Fastener	8 N•m	71 lb in
Instrument Panel Compartment Door Latch Striker Fastener	8 N•m	71 lb in
Instrument Panel Inflatable Restraint Module Bracket Fastener	11.5 N•m	8 lb ft
Instrument Panel Upper Trim Fastener	7 N•m	62 lb in

Repair Instructions

Instrument Panel Knee Bolster Replacement



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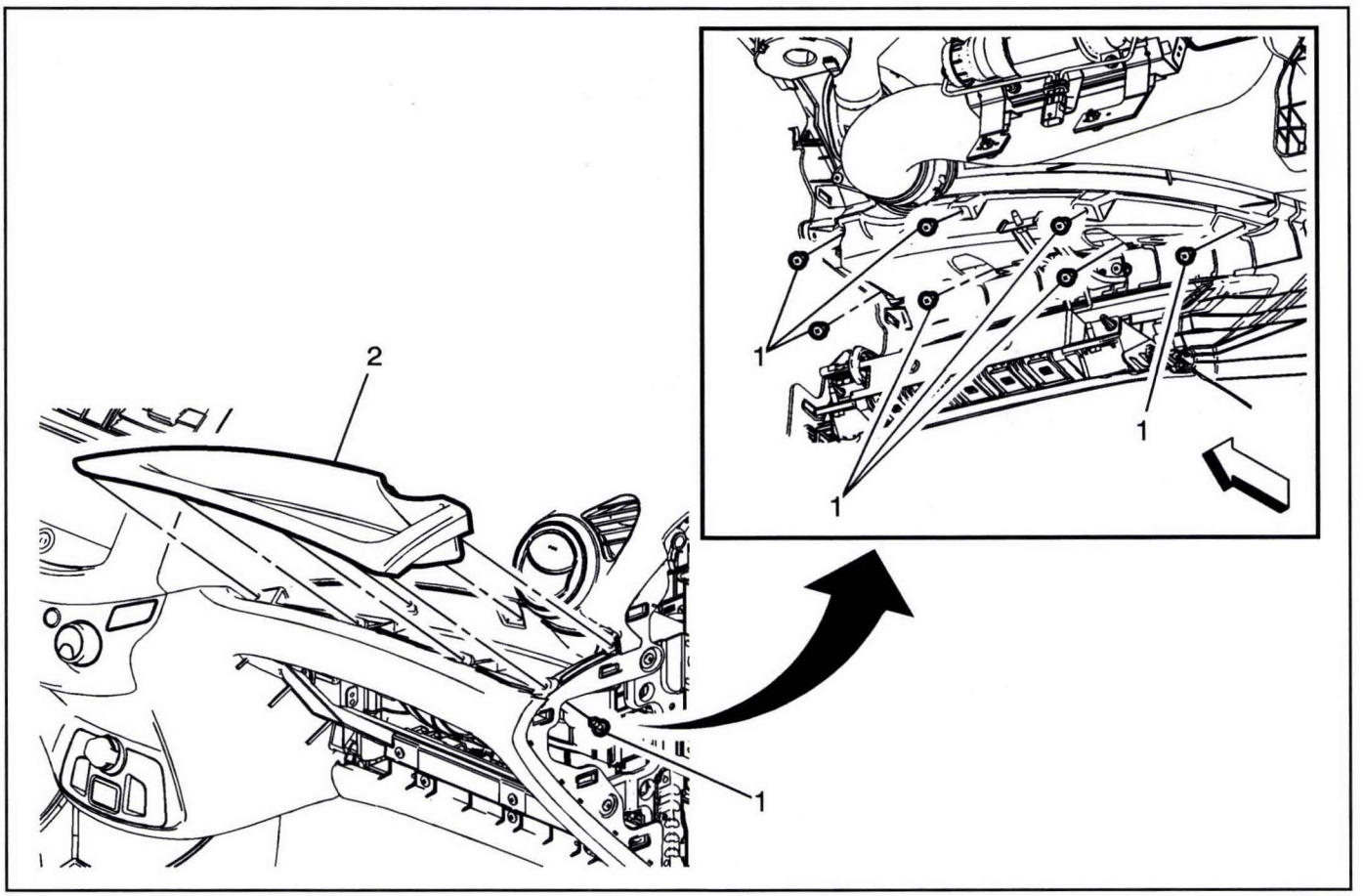
Instrument Panel Knee Bolster Replacement

Callout	Component Name
1	Instrument Panel Knee Bolster Bolt (Qty: 4) **Caution:** Refer to *Fastener Caution on page 0-8*.

Instrument Panel Knee Bolster Replacement (cont'd)

Callout	Component Name
2	Instrument Panel Knee Bolster **Procedure** Use a flat bladed plastic trim tool in order to release the retainers securing the knee bolster to the instrument panel assembly.

Instrument Panel Trim Plate Applique Replacement - Right Side



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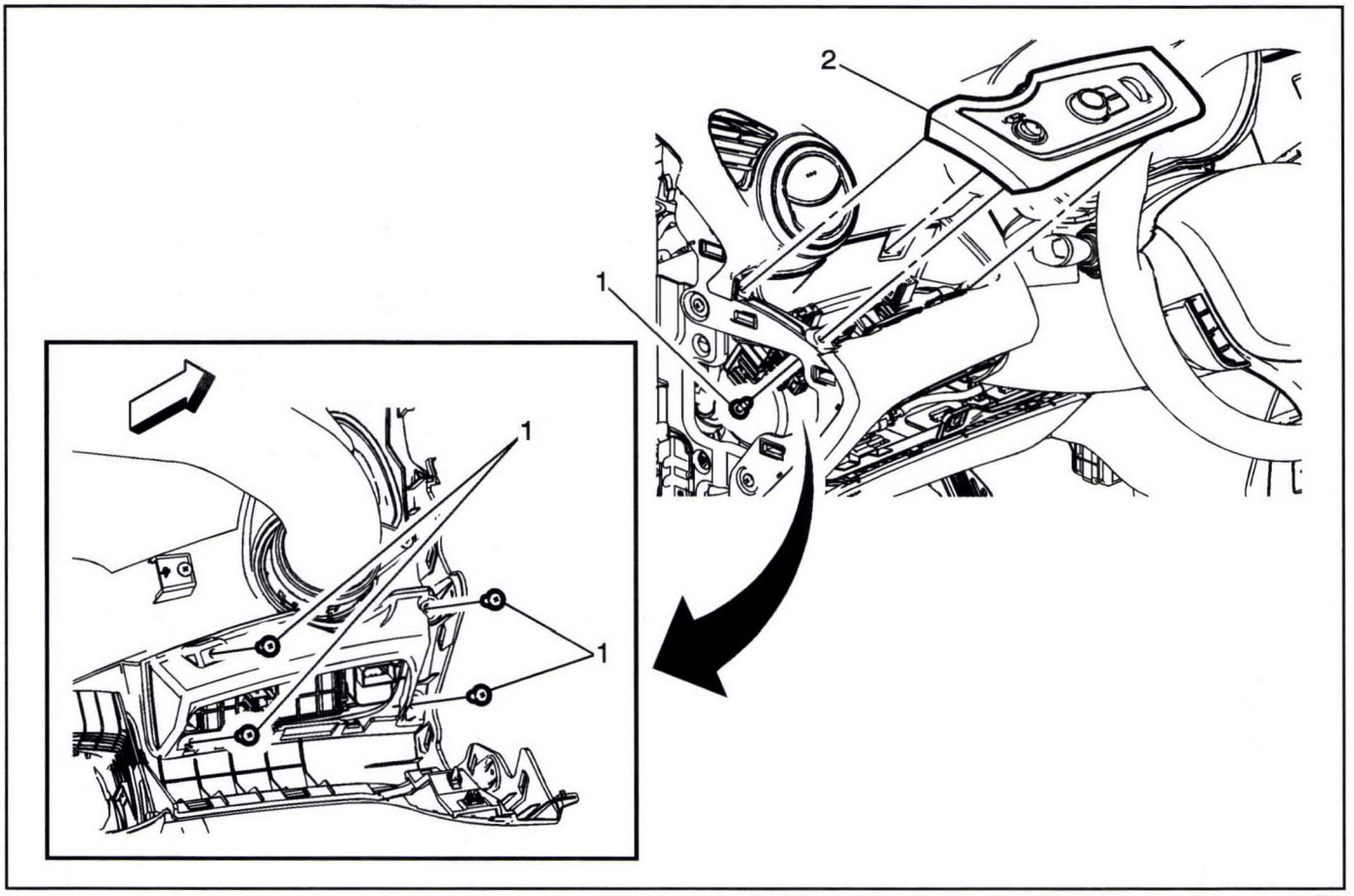
Instrument Panel Trim Plate Applique Replacement - Right Side

Callout	Component Name
Preliminary Procedure Remove the instrument panel trim pad. Refer to *Instrument Panel Trim Pad Replacement on page 2-31*.	
1	Instrument Panel Bolt (Qty: 7) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Instrument Panel Trim Plate Applique - Right

Instrument Panel Trim Plate Applique Replacement - Left Side



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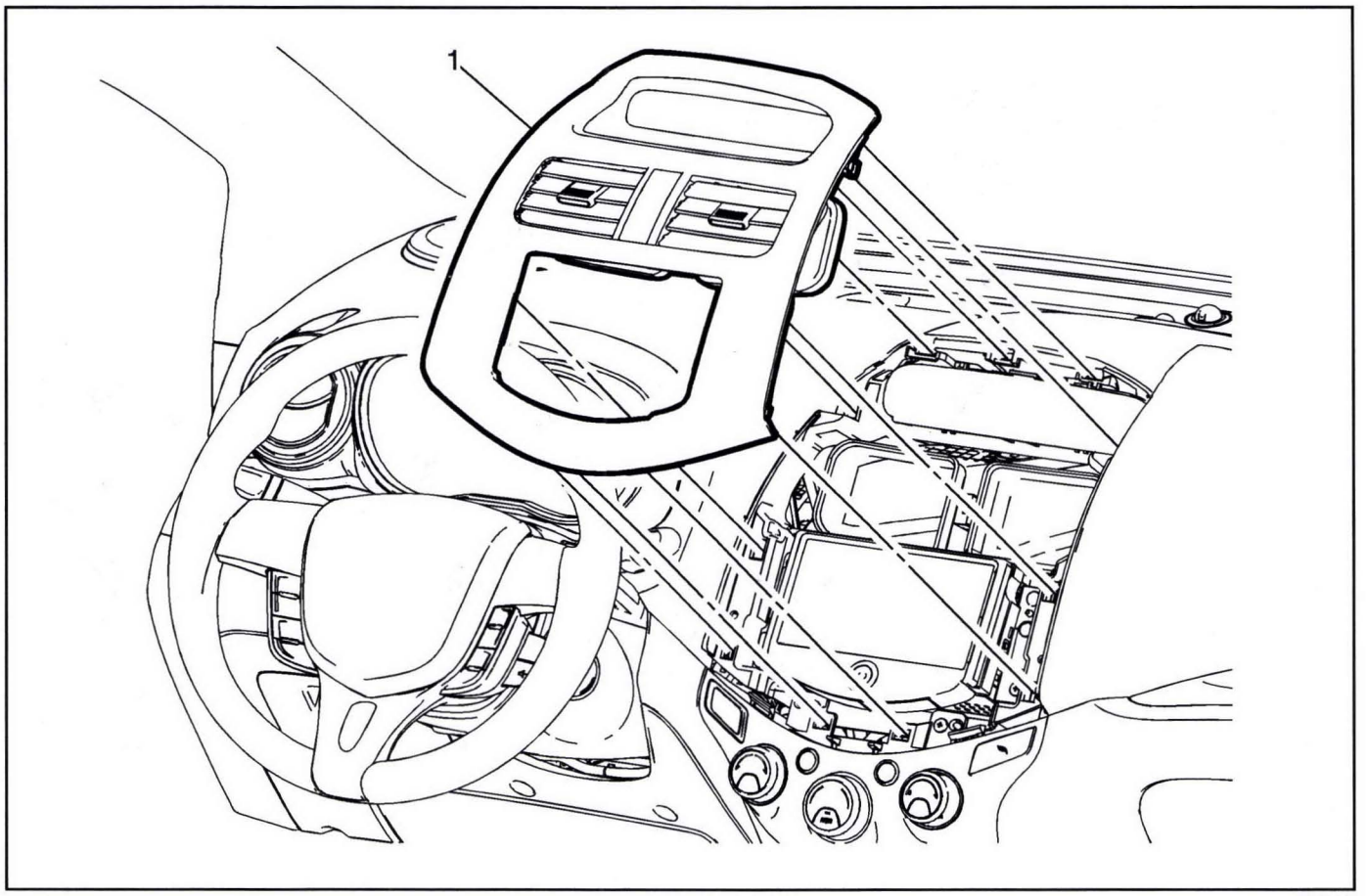
Instrument Panel Trim Plate Applique Replacement - Left Side

Callout	Component Name
Preliminary Procedure Remove the instrument panel trim pad. Refer to *Instrument Panel Trim Pad Replacement on page 2-31*.	
1	Instrument Panel Bolt (Qty: 4) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Instrument Panel Trim Plate Applique - Left **Procedure** 1. Disconnect the electrical connector. 2. Transfer components as necessary.

Instrument Panel Center Trim Plate Applique Replacement



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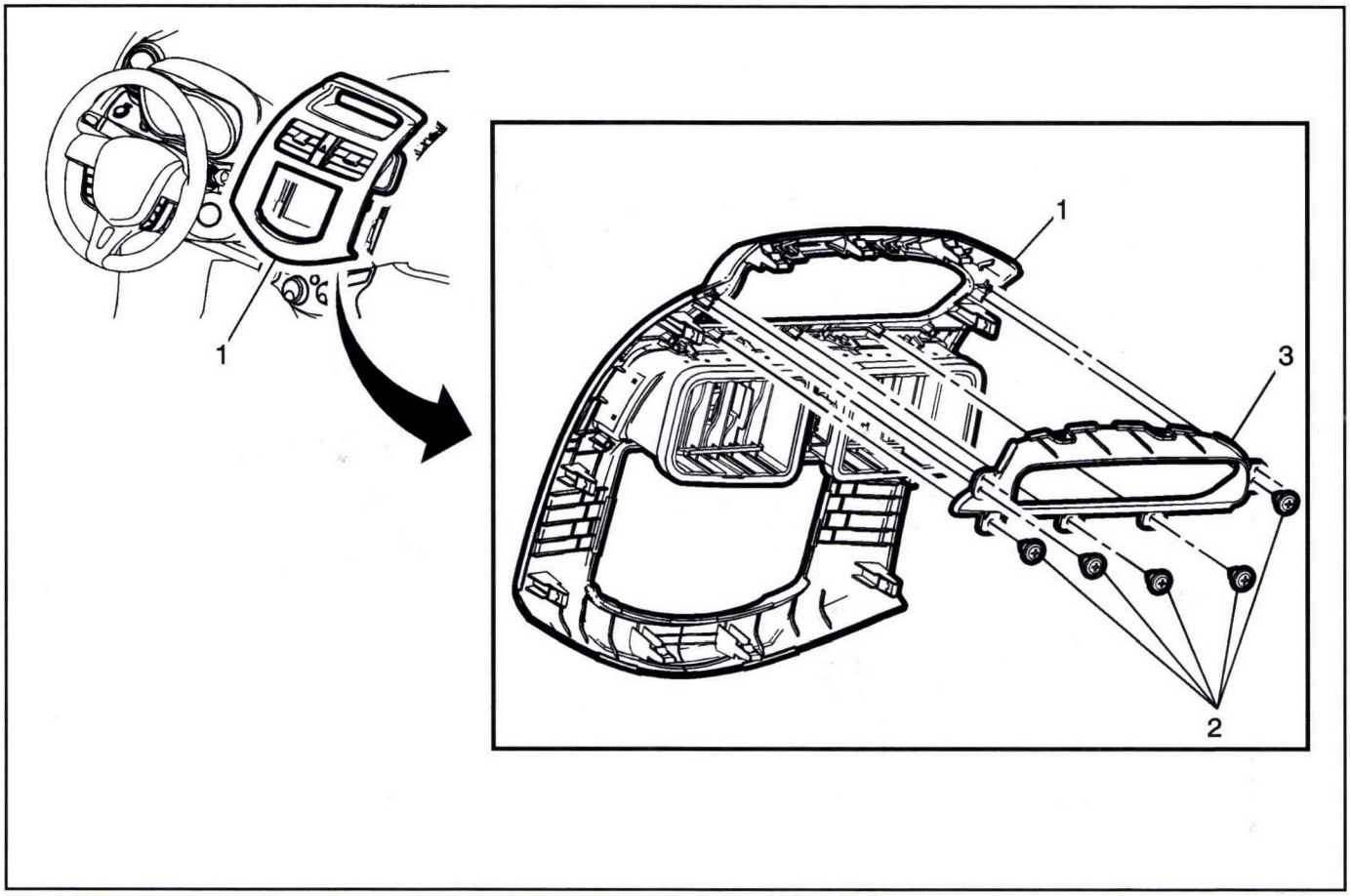
Instrument Panel Center Trim Plate Applique Replacement

Callout	Component Name
1	Instrument Panel Center Trim Plate Applique **Procedures** 1. Use a flat bladed plastic trim tool to aid in the removal of the trim plate applique from the instrument panel assembly. Starting at the bottom of the trim plate. 2. Disconnect the electrical connection. 3. Transfer components as necessary.

Instrument Panel Upper Molding Retainer Replacement



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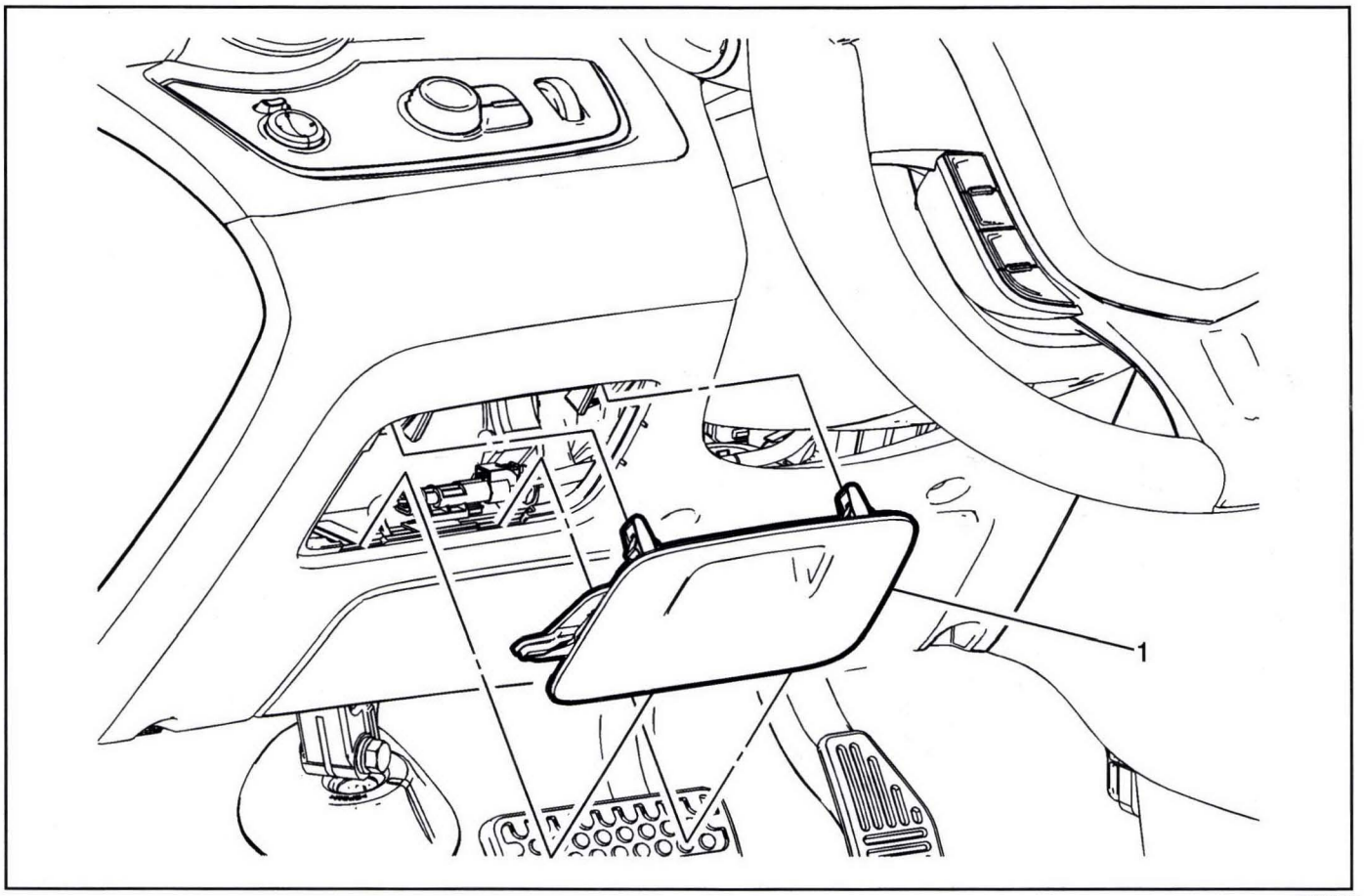
Instrument Panel Upper Molding Retainer Replacement

Callout	Component Name
1	Instrument Panel Center Trim Plate Applique Refer to *Instrument Panel Center Trim Plate Applique Replacement on page 2-25*.
2	Instrument Panel Center Molding Bolt (Qty: 5) **Caution:** Refer to *Fastener Caution on page 0-8*.
3	Instrument Panel Upper Molding Retainer

Instrument Panel Fuse Block Access Hole Cover Replacement



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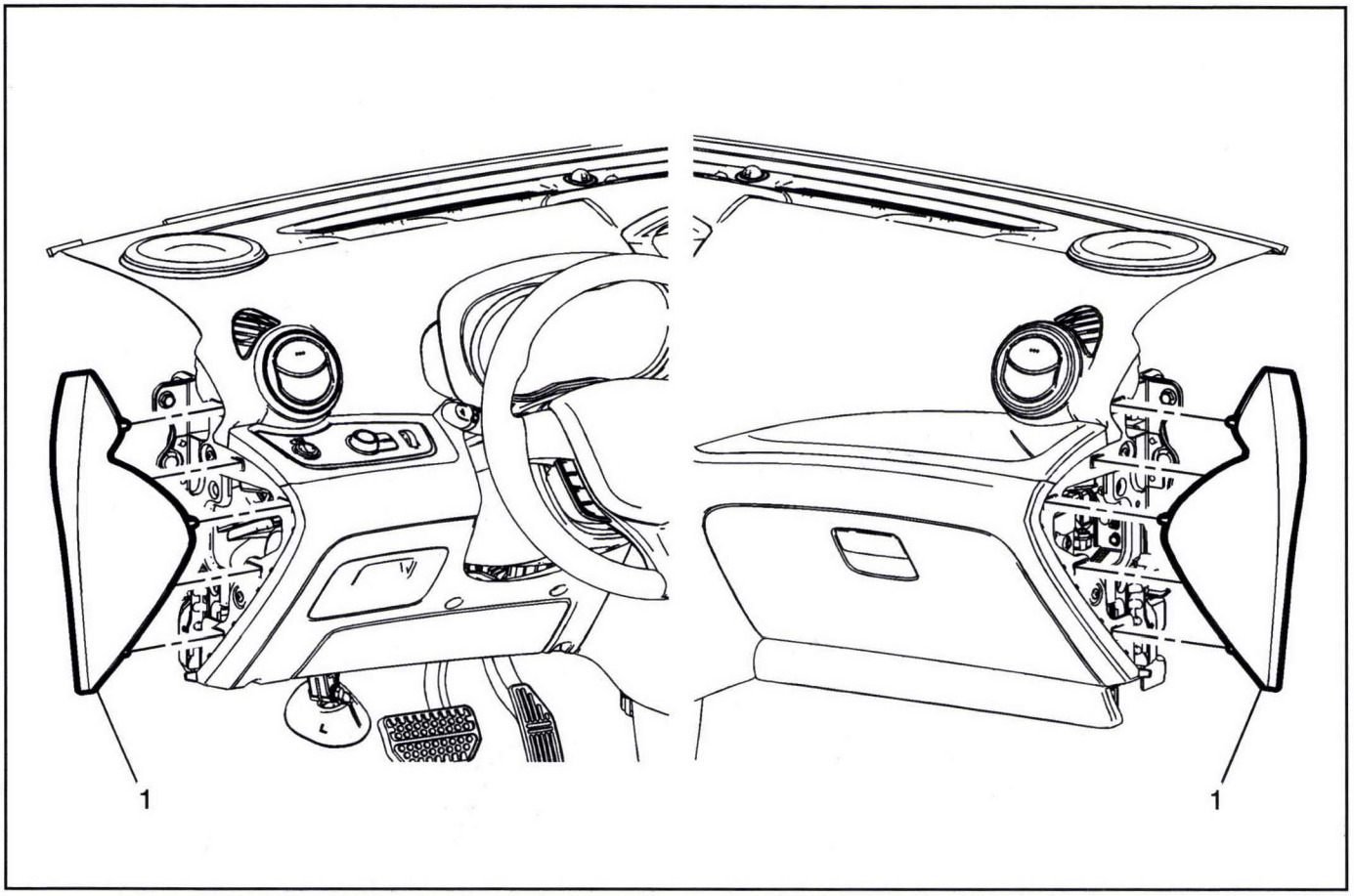
Instrument Panel Fuse Block Access Hole Cover Replacement

Callout	Component Name
1	Instrument Panel Fuse Block Access Hole Cover **Procedure** Grasp the fuse block cover and pull outward disengaging the retainers securing the fuse block cover to the knee bolster.

Instrument Panel Outer Trim Cover Replacement

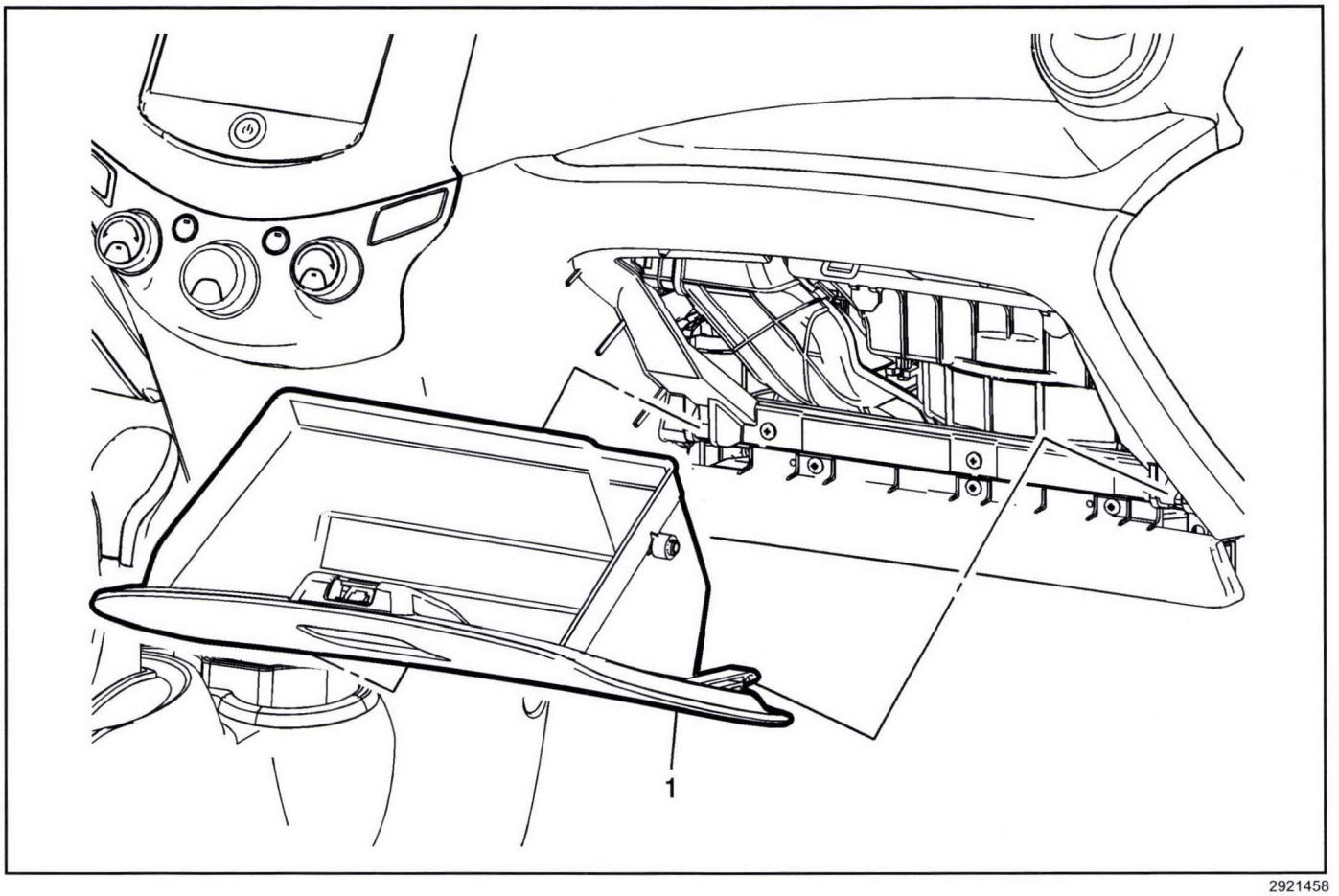


2920853

Instrument Panel Outer Trim Cover Replacement

Callout	Component Name
1	Instrument Panel Outer Trim Cover **Procedures** 1. Use a flat bladed plastic trim tool to aid in the removal of the trim cover from the instrument panel assembly. 2. If equipped with a Inflatable Restraint Disable Switch, disconnect the electrical connection. 3. Transfer components as necessary.

Instrument Panel Compartment Replacement

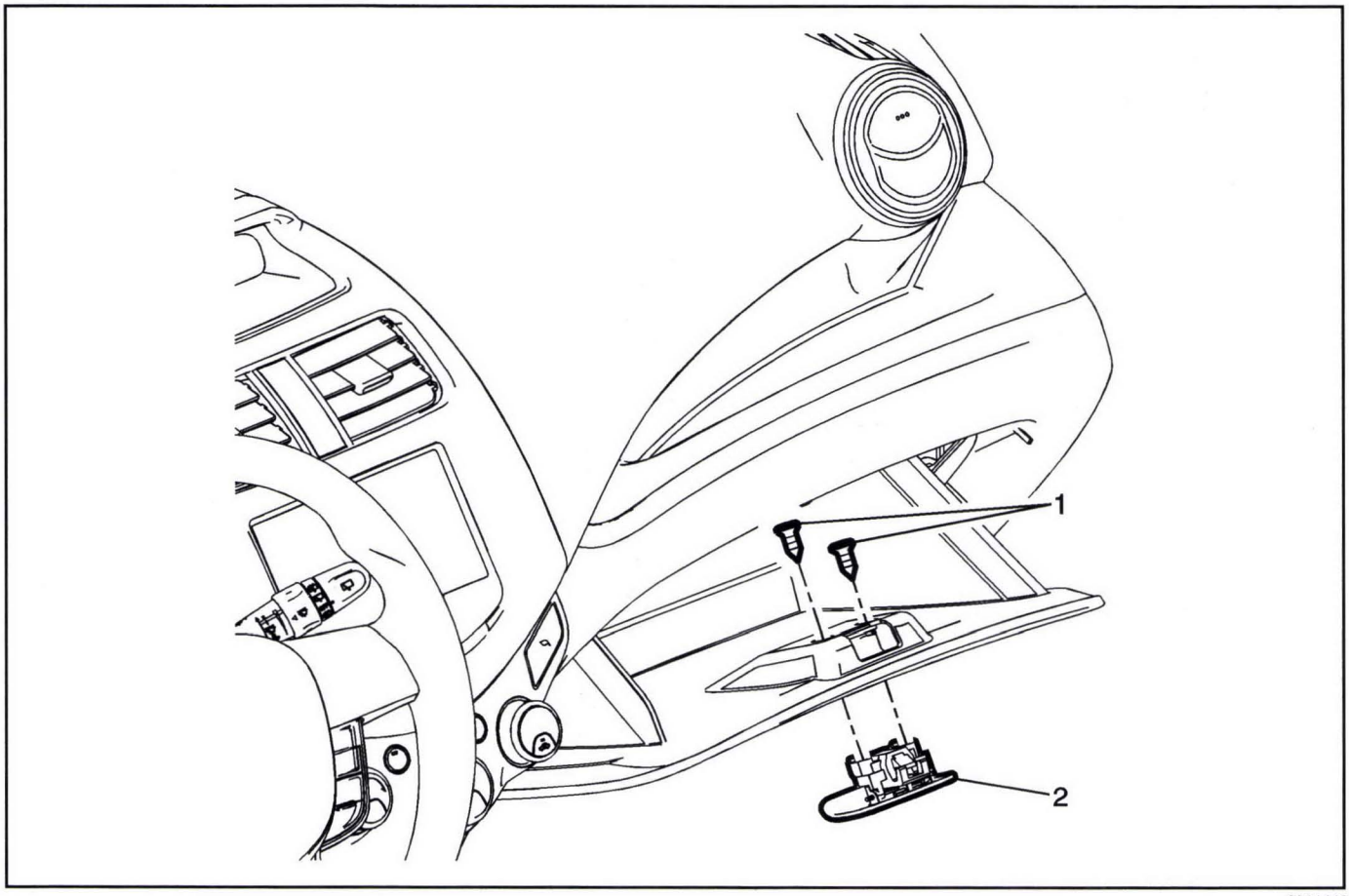


2921458

Instrument Panel Compartment Replacement

Callout	Component Name
1	Instrument Panel Compartment Door **Procedures** 1. Squeeze the sides of the instrument panel compartment allowing the compartment to open past the stops. 2. Pull out the instrument panel compartment to disconnect the hinge.

Instrument Panel Compartment Door Latch Replacement

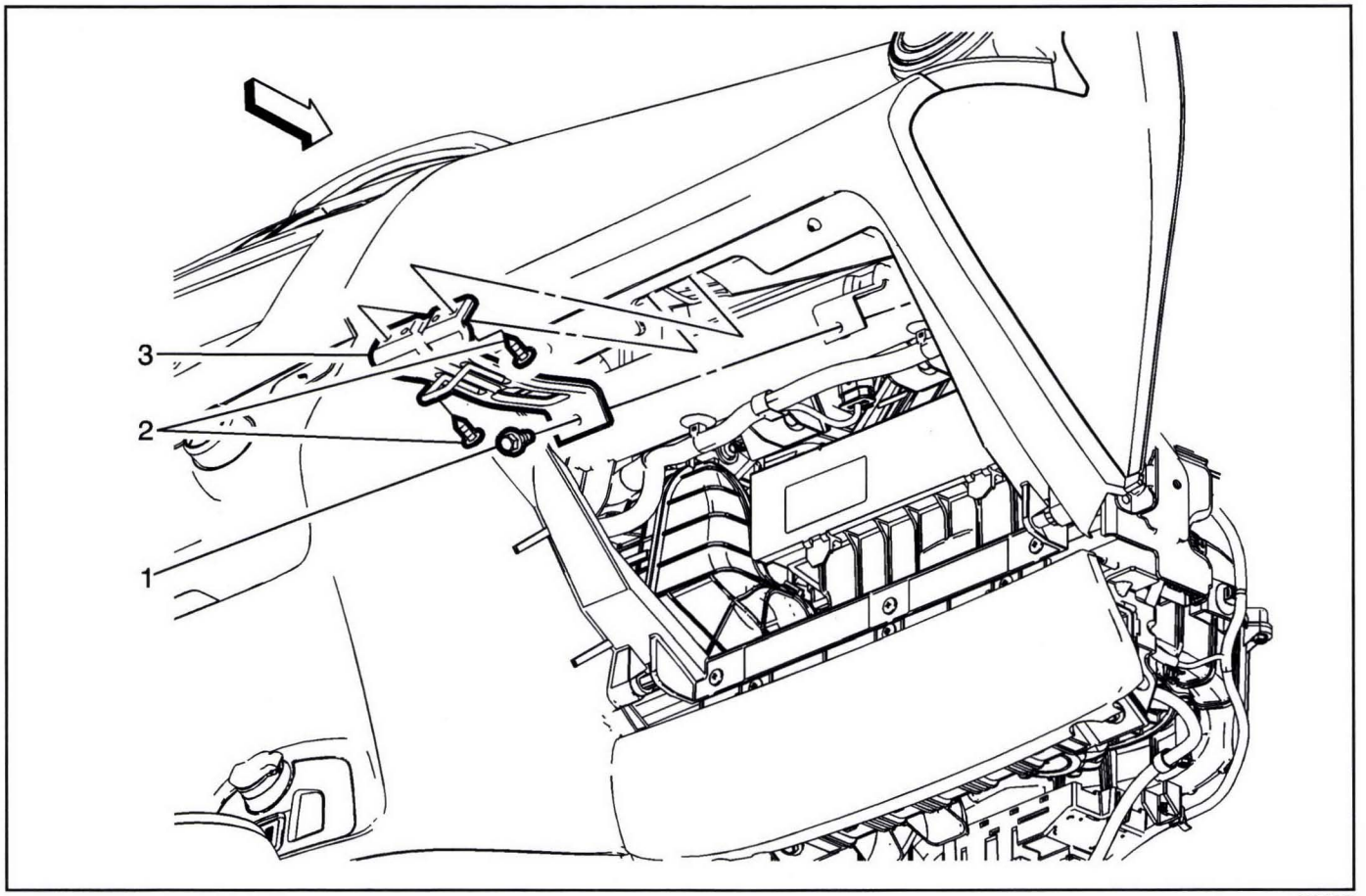


2921448

Instrument Panel Compartment Door Latch Replacement

Callout	Component Name
1	Instrument Panel Compartment Door Lock Screw (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Instrument Panel Compartment Door Latch

Instrument Panel Compartment Door Latch Striker Replacement



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Instrument Panel Compartment Door Latch Striker Replacement

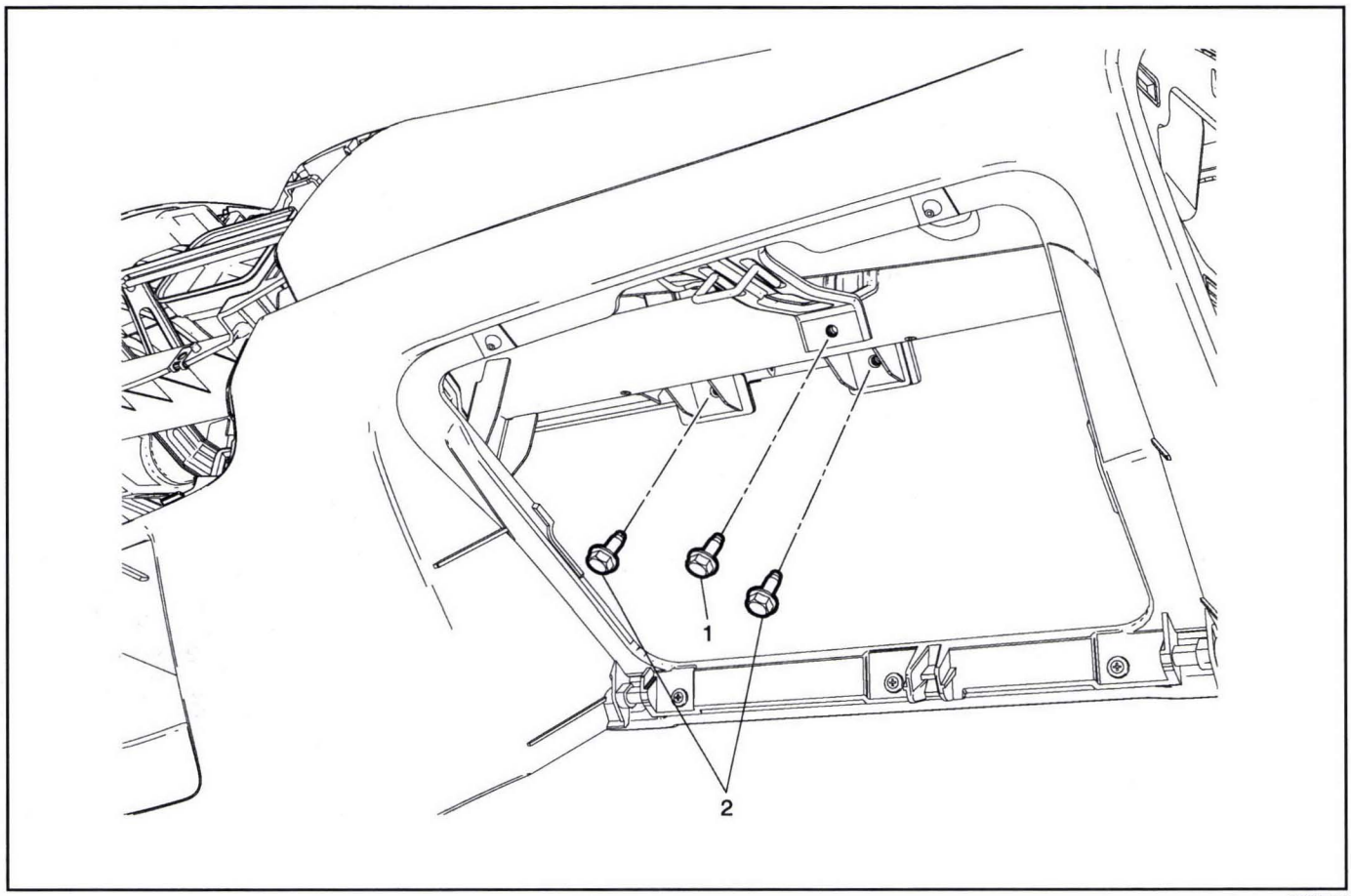
Callout	Component Name
Preliminary Procedure Remove the instrument panel compartment. Refer to *Instrument Panel Compartment Replacement on page 2-29*.	
1	Instrument Panel Compartment Door Latch Striker Bolt **Caution:** Refer to *Fastener Caution on page 0-8*. 8 N•m (71 lb in)
2	Instrument Panel Compartment Door Latch Striker Screw (Qty: 2)
3	Instrument Panel Compartment Door Latch Striker

Instrument Panel Trim Pad Replacement

Removal Procedure

1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Remove the windshield garnish molding. Refer to *Windshield Garnish Molding Replacement on page 2-61*.
3. Remove the floor console assembly. Refer to *Front Floor Console Replacement on page 2-48*.
4. Remove the radio assembly. Refer to *Radio Replacement on page 8-57*.
5. Remove the auxiliary heater and air conditioning control. Refer to *Auxiliary Heater and Air Conditioning Control Replacement on page 10-135*.
6. Remove both instrument panel outer trim covers. Refer to *Instrument Panel Outer Trim Cover Replacement on page 2-28*.
7. Remove the instrument panel compartment. Refer to *Instrument Panel Compartment Replacement on page 2-29*.
8. Remove the passenger instrument panel lower airbag. Refer to *Instrument Panel Lower Airbag Replacement - Passenger Side on page 12-161*.
9. Remove the instrument cluster. Refer to *Instrument Cluster Replacement on page 8-95*.
10. Remove the steering column. Refer to *Steering Column Replacement on page 14-34*.

11. Remove both front speakers. Refer to *Radio Front Speaker Replacement on page 8-61*.



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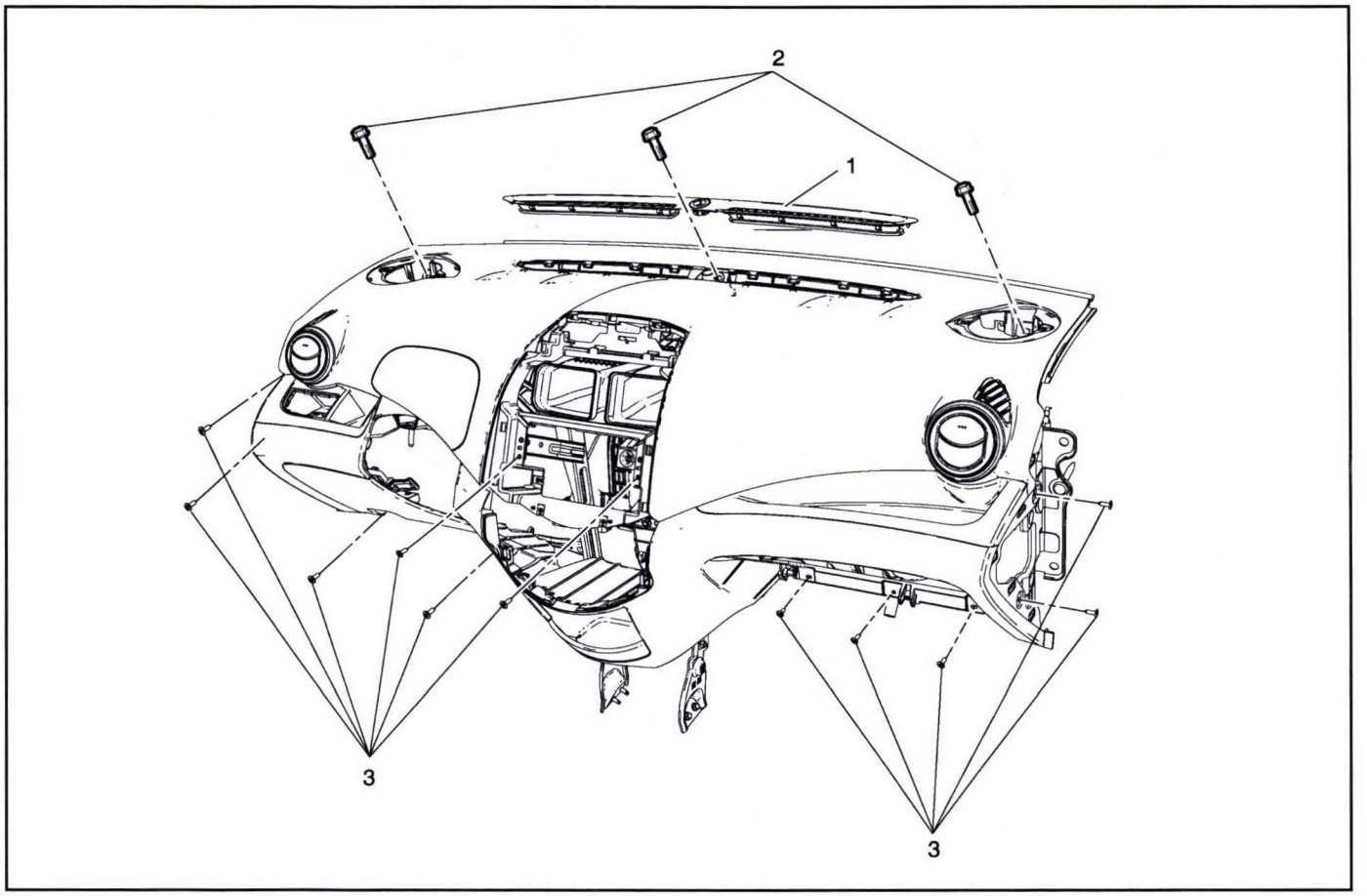
12. Remove the instrument panel compartment door latch striker bolt (1) and the instrument panel inflatable restraint module bolts (2).
13. Disconnect the passenger airbag module electrical connector.



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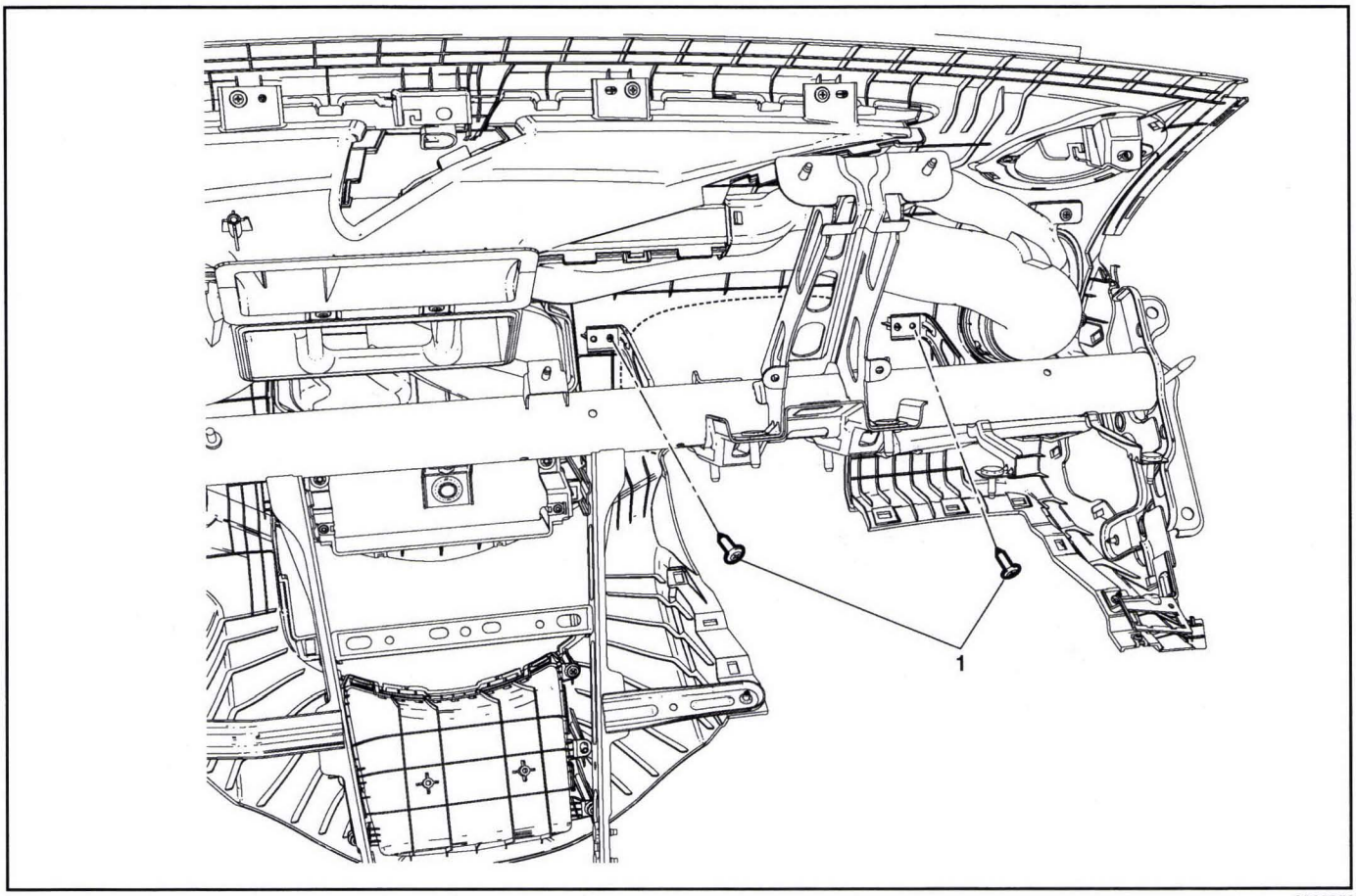
14. Remove the instrument panel defroster grille (1).
15. Remove the instrument panel upper trim bolts (2).
16. Remove the instrument panel screws (3).



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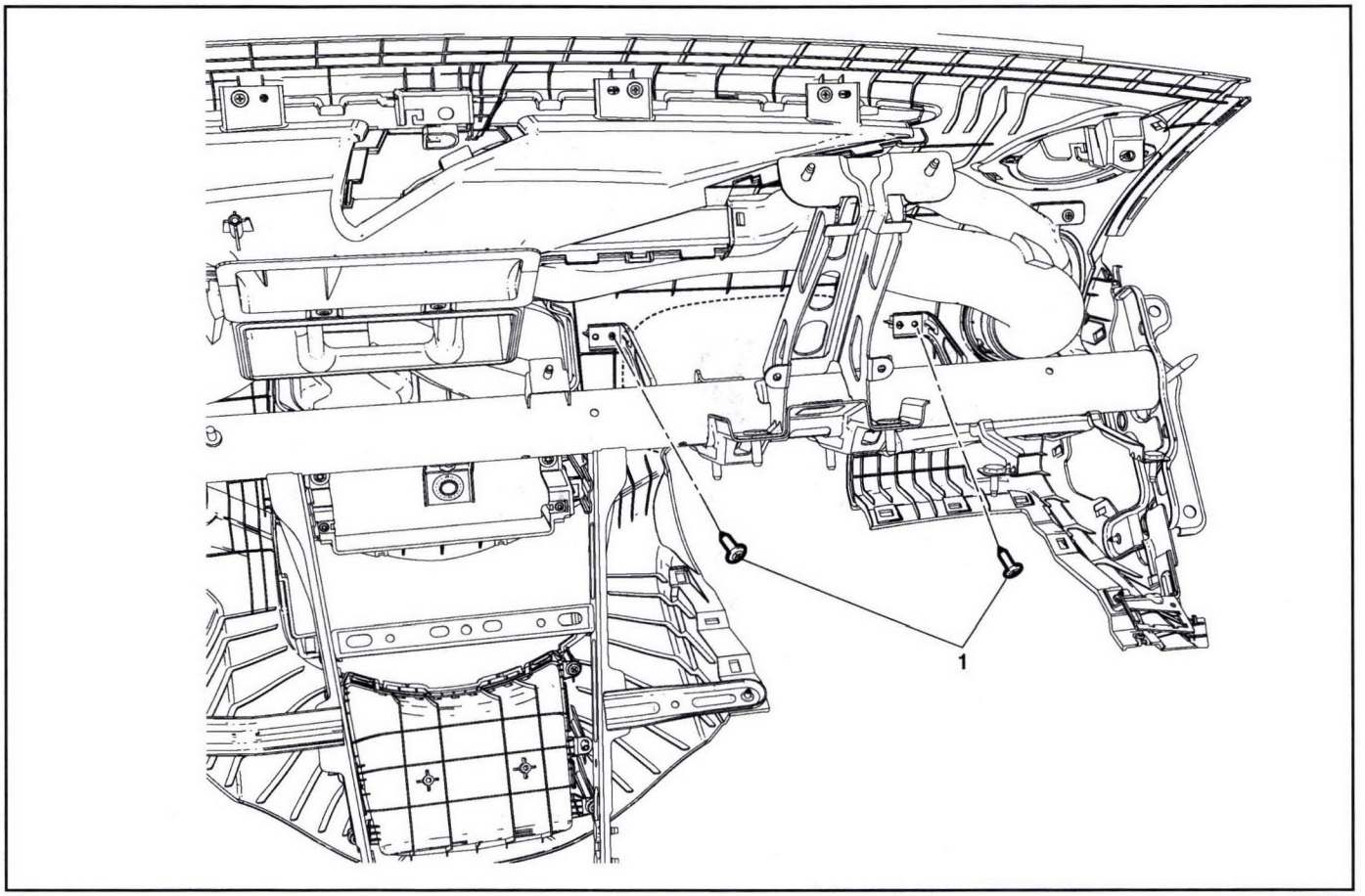
17. Remove the instrument panel screw (1) behind the instrument panel of driver side.
18. Remove the instrument panel assembly from the vehicle.

Installation Procedure



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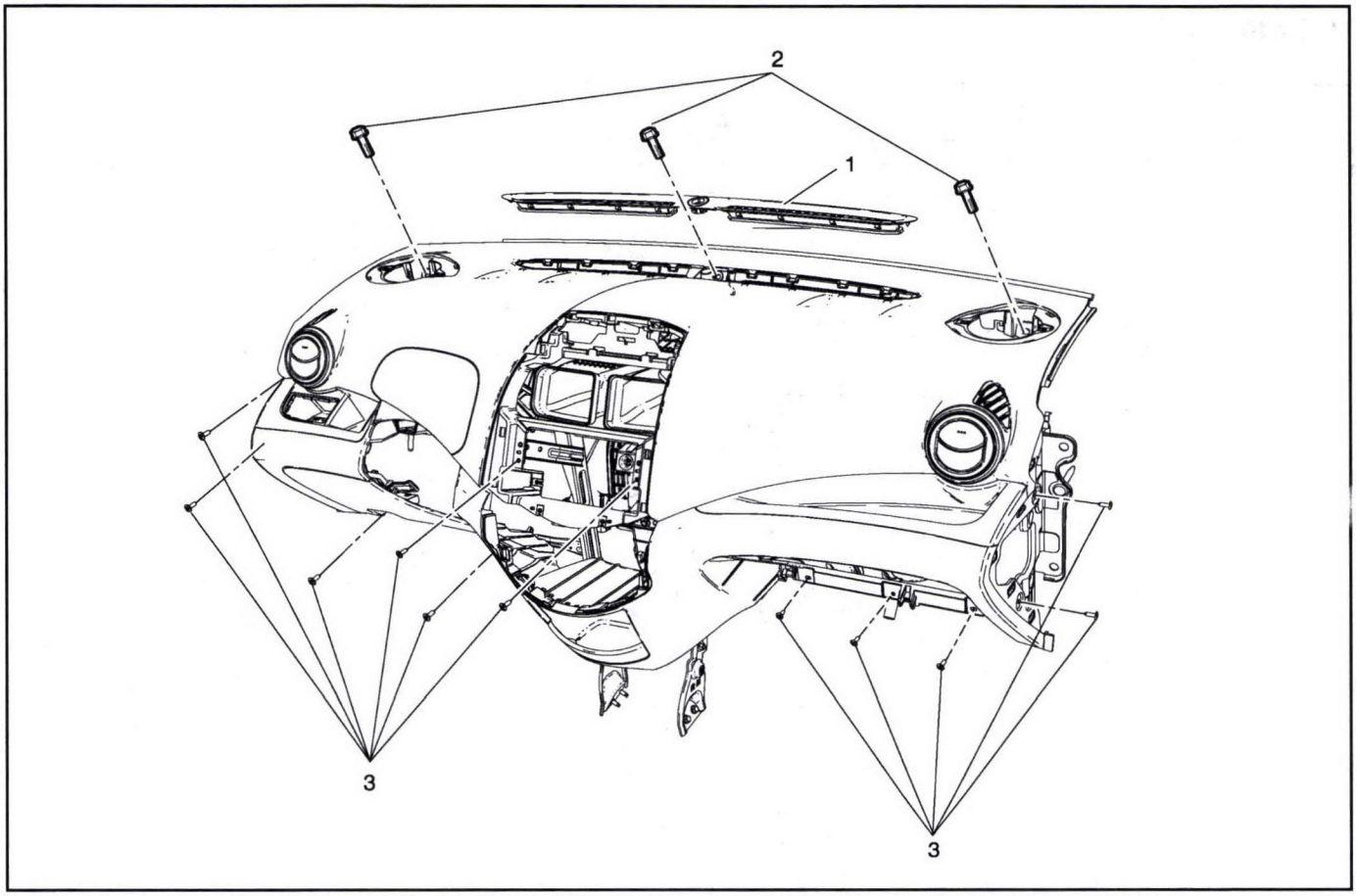
Caution: Refer to *Fastener Caution on page 0-8*.

1. Install the instrument panel assembly on the vehicle.
2. Install the instrument panel screw (1) behind the I/P of the driver side and tighten.



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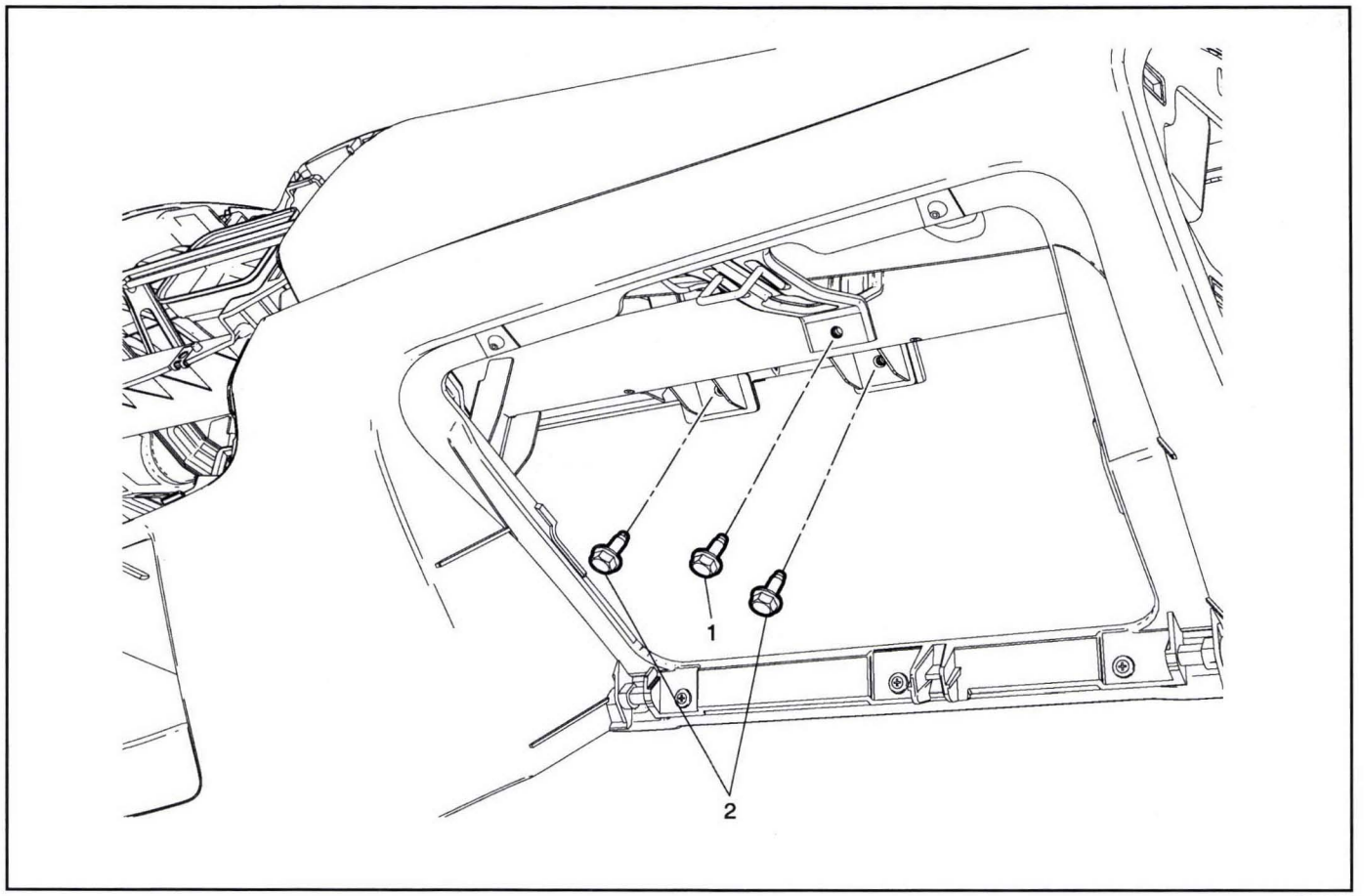
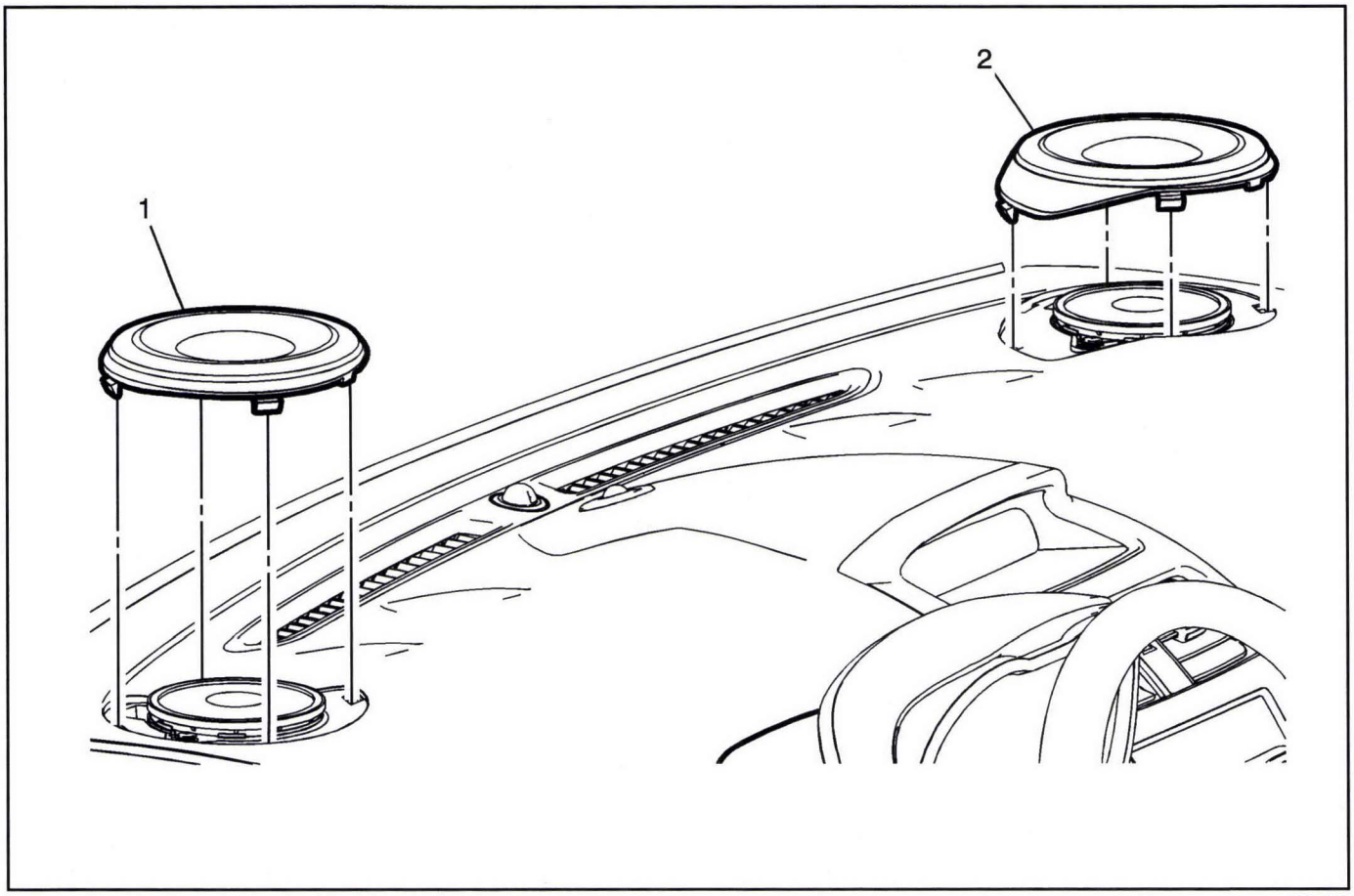
3. Install the instrument panel screws (3) and tighten.
4. Install the instrument panel upper trim bolts (2) and tighten to **7** N•m **(62 lb in)**.
5. Install the instrument panel defroster grille (1).



2309404

6. Connect the passenger airbag module electrical connector.
7. Install the instrument panel compartment door latch striker bolt (1) and tighten to **8** N•m **(71 lb in)**.
8. Install the instrument panel inflatable restraint module bolts (2) and tighten to **11.5** N•m **(8 lb ft)**.
9. Install both front speakers. Refer to *Radio Front Speaker Replacement on page 8-61*.
10. Install the steering column. Refer to *Steering Column Replacement on page 14-34*.
11. Install the instrument cluster. Refer to *Instrument Cluster Replacement on page 8-95*.
12. Install the passenger instrument panel lower airbag. Refer to *Instrument Panel Lower Airbag Replacement - Passenger Side on page 12-161*.
13. Install the instrument panel compartment. Refer to *Instrument Panel Compartment Replacement on page 2-29*.
14. Install both instrument panel outer trim covers. Refer to *Instrument Panel Outer Trim Cover Replacement on page 2-28*.
15. Install the auxiliary heater and air conditioning control. Refer to *Auxiliary Heater and Air Conditioning Control Replacement on page 10-135*.
16. Install the radio assembly. Refer to *Radio Replacement on page 8-57*.
17. Install the floor console assembly. Refer to *Front Floor Console Replacement on page 2-48*.
18. Install the windshield garnish molding. Refer to *Windshield Garnish Molding Replacement on page 2-61*.
19. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

Instrument Panel Trim Pad Radio Speaker Opening Cover Replacement



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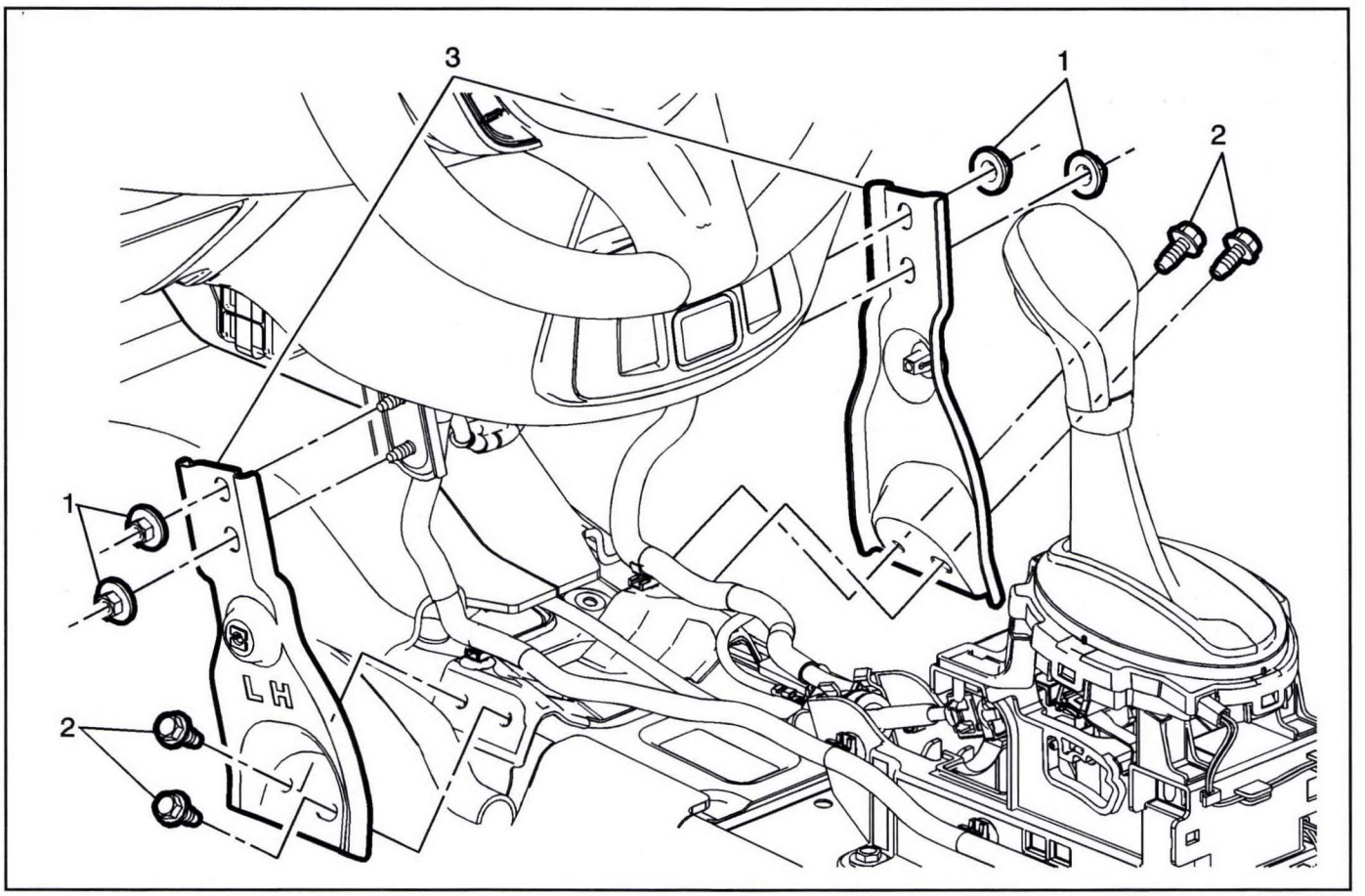
Instrument Panel Trim Pad Radio Speaker Opening Cover Replacement

Callout	Component Name
1	Instrument Panel Trim Pad Radio Speaker Opening Cover - Left **Procedure** Use a flat bladed plastic trim tool to aid in the removal of the speaker cover from the instrument panel assembly.
2	Instrument Panel Trim Pad Radio Speaker Opening Cover - Right **Procedure** Use a flat bladed plastic trim tool to aid in the removal of the speaker cover from the instrument panel assembly.

Instrument Panel Center Support Bracket Replacement



2966924

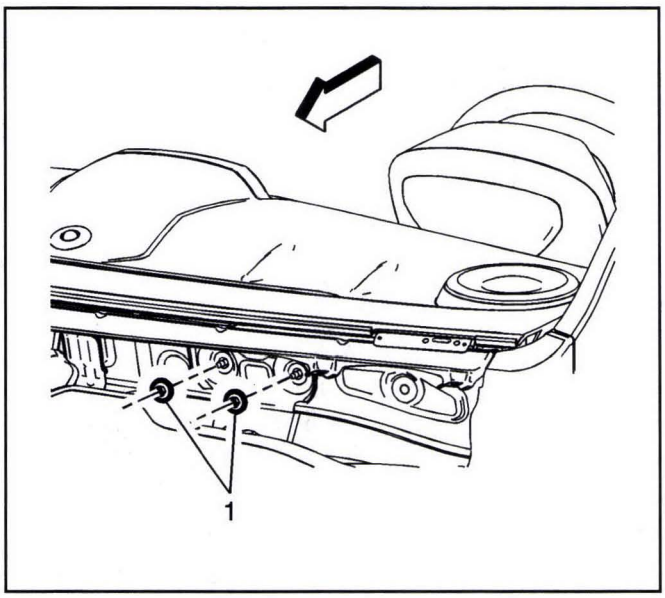
Instrument Panel Center Support Bracket Replacement

Callout	Component Name
Preliminary Procedure Remove the front floor console. Refer to *Front Floor Console Replacement on page 2-48*.	
1	Instrument Panel Center Support Bracket Nut (Qty: 4) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 8 N•m (71 lb in)
2	Instrument Panel Center Support Bracket Bolt (Qty: 4) **Procedure** Pull back the carpet and insulator to access the fasteners from the floor tunnel. **Tighten** 8 N•m (71 lb in)
3	Instrument Panel Center Support Bracket (Left or Right)

Instrument Panel Tie Bar Replacement

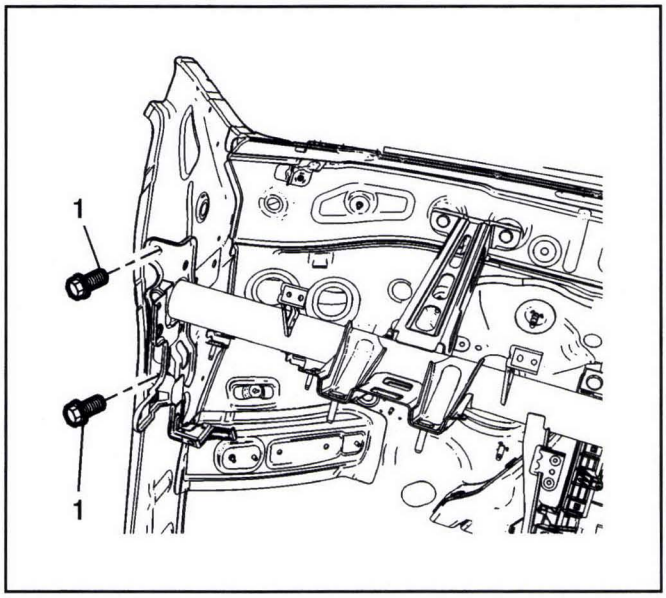
Removal Procedure

1. Remove the windshield wiper motor. Refer to *Windshield Wiper Motor Replacement on page 4-332*.
2. Remove the instrument panel trim pad. Refer to *Instrument Panel Trim Pad Replacement on page 2-31*.



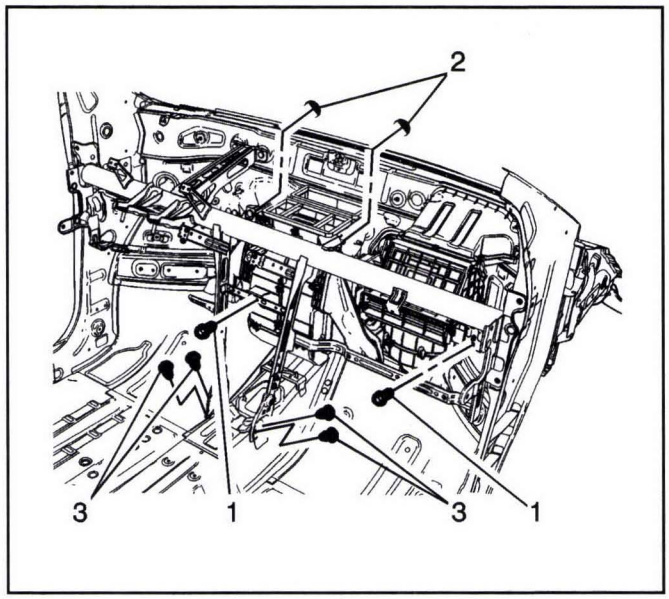
3350354

3. Remove the instrument panel tie bar nuts (1).



2968300

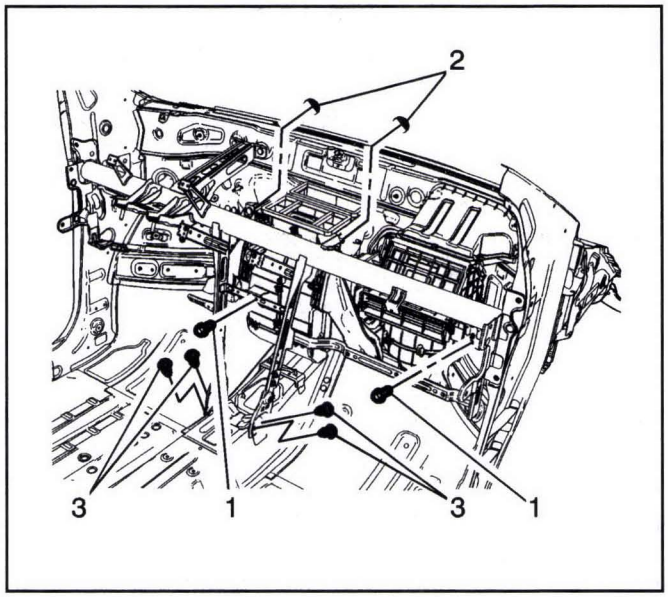
4. Remove the instrument panel wiring harness from the instrument panel tie bar.
5. Remove the instrument panel bolts (1) from the side body panel.



2968303

6. Remove the heater and air conditioning evaporator and blower module bolts (1) and nuts (2).
7. Remove the instrument panel center support bracket bolts (3).
8. Remove the instrument panel tie bar assembly from the vehicle.

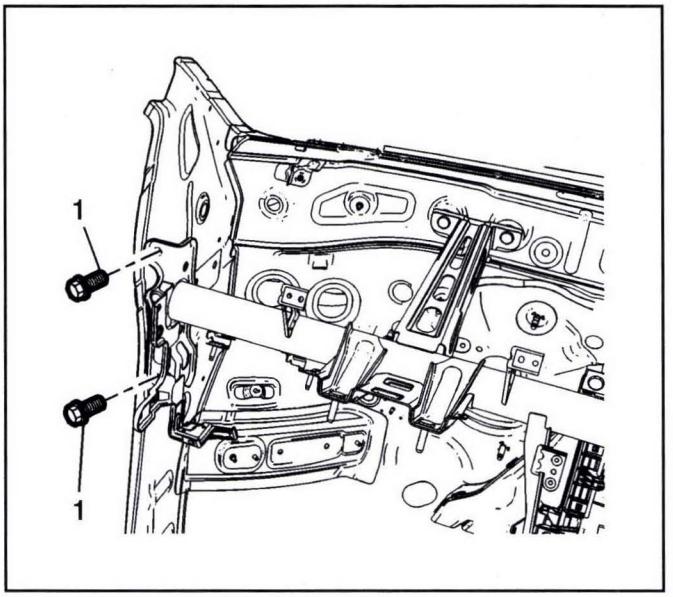
Installation Procedure



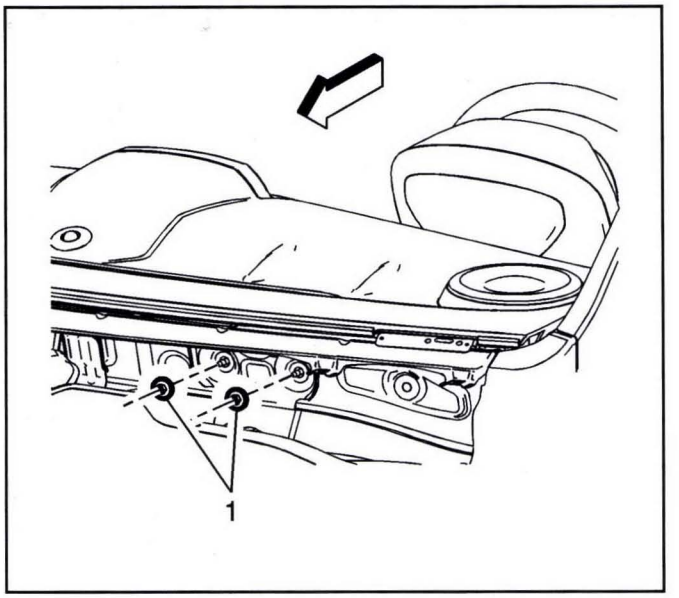
2968303

Caution: Refer to *Fastener Caution on page 0-8*.

1. Install the instrument panel tie bar assembly on the vehicle.
2. Install the heater and air conditioning evaporator and blower module bolts (1) and nuts (2) and tighten to **6** N•m **(53 lb in)**.
3. Install the instrument panel center support bracket bolts (3) and tighten to **8** N•m **(71 lb in)**.



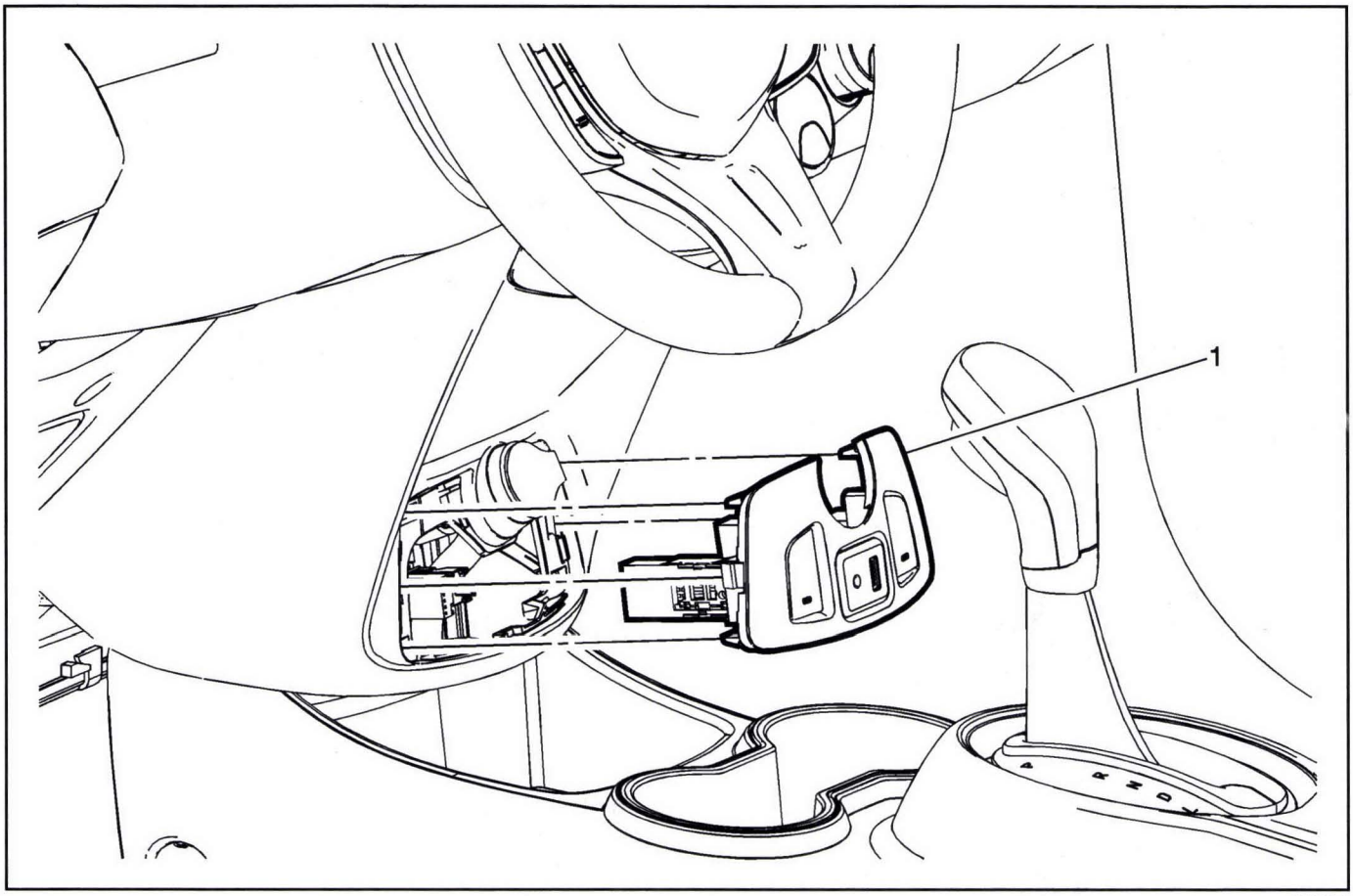
2968300



3350354

4. Install the instrument panel bolts (1) to side body panel and tighten to **22** N•m **(16 lb ft)**.
5. Install the instrument panel tie bar nuts (1) and tighten to **22** N•m **(16 lb ft)**.
6. Install the instrument panel wiring harness to the instrument panel tie bar.
7. Install the instrument panel trim pad. Refer to *Instrument Panel Trim Pad Replacement on page 2-31*.
8. Install the windshield wiper motor. Refer to *Windshield Wiper Motor Replacement on page 4-332*.

Front Seat Heater Switch Bezel Replacement

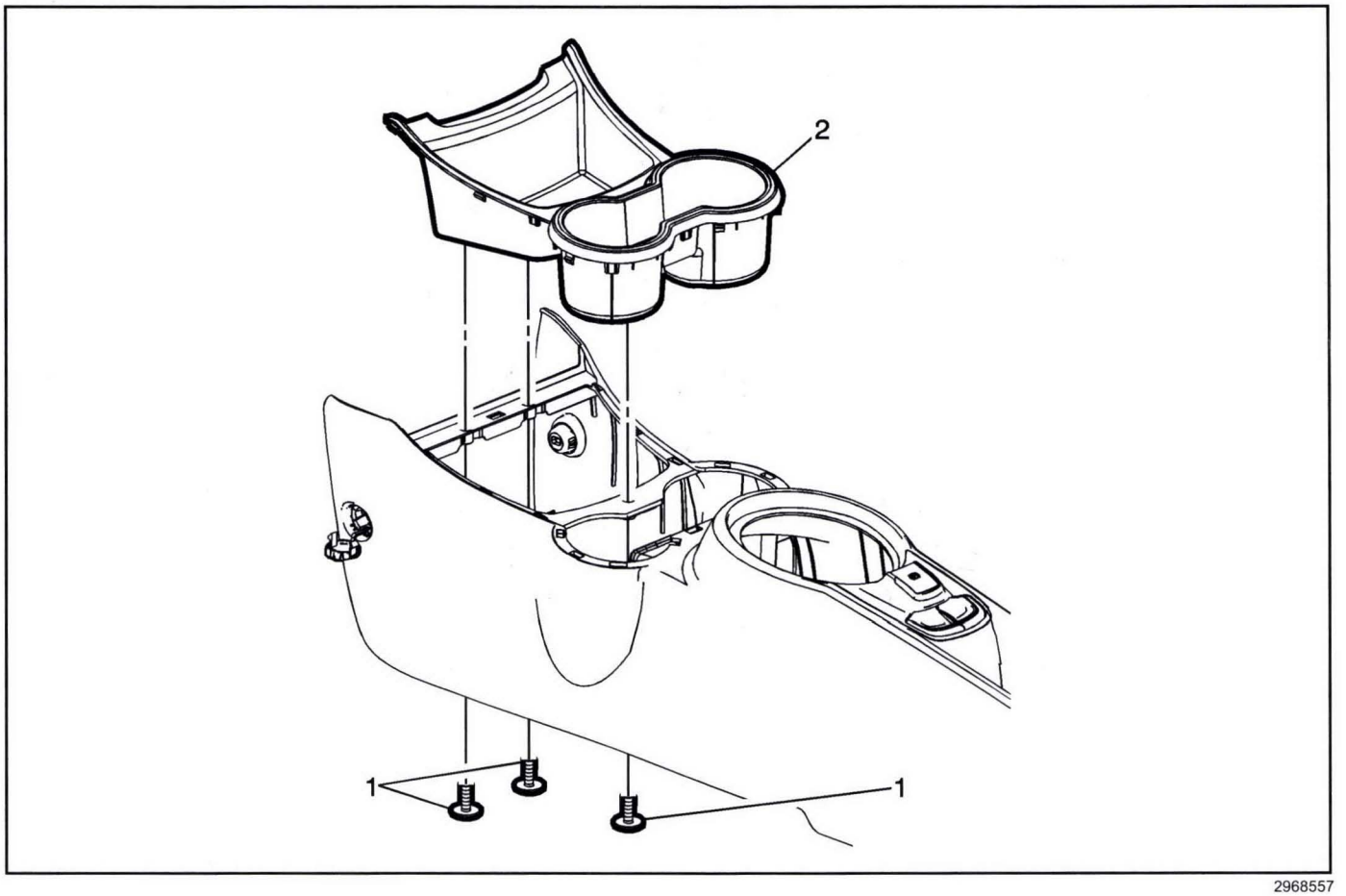


2968775

Front Seat Heater Switch Bezel Replacement

Callout	Component Name
1	Front Seat Heater Switch Bezel **Procedures** 1. Use a flat bladed plastic trim tool to aid in the removal of the switch bezel from the instrument panel assembly. 2. Disconnect all electrical connectors. 3. Transfer components as necessary.

Front Floor Console Front Compartment Replacement

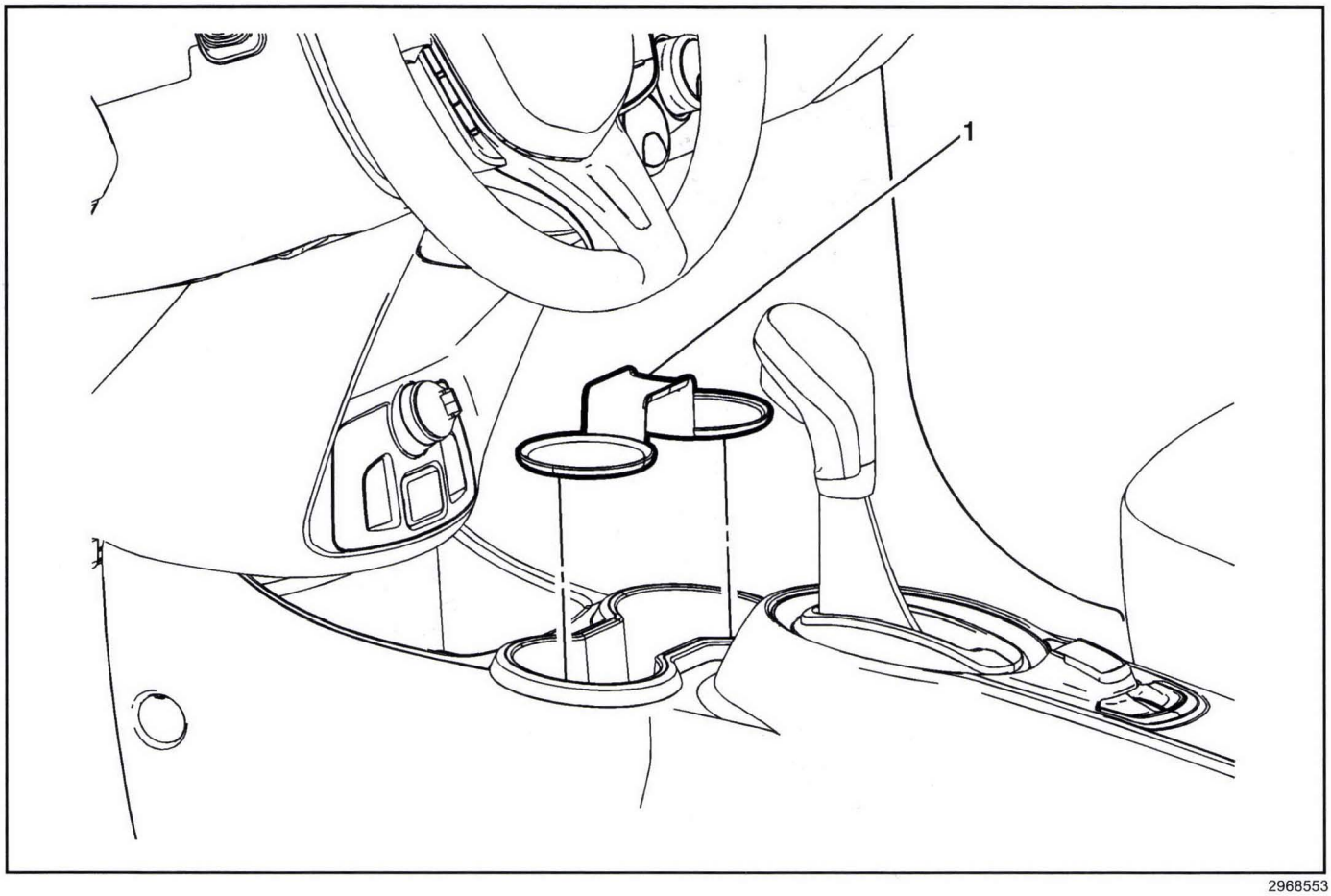


2968557

Front Floor Console Front Compartment Replacement

Callout	Component Name
Preliminary Procedure Remove the front floor console to access the tabs and fasteners for the front floor console front compartment. Refer to *Front Floor Console Replacement on page 2-48*.	
1	Front Floor Console Storage Tray Bolt (Qty: 3) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Front Floor Console Front Compartment **Procedure** Use a suitable tool in order to release the tabs securing the front floor console compartment to the front floor console assembly.

Front Floor Console Cup Holder Liner Replacement

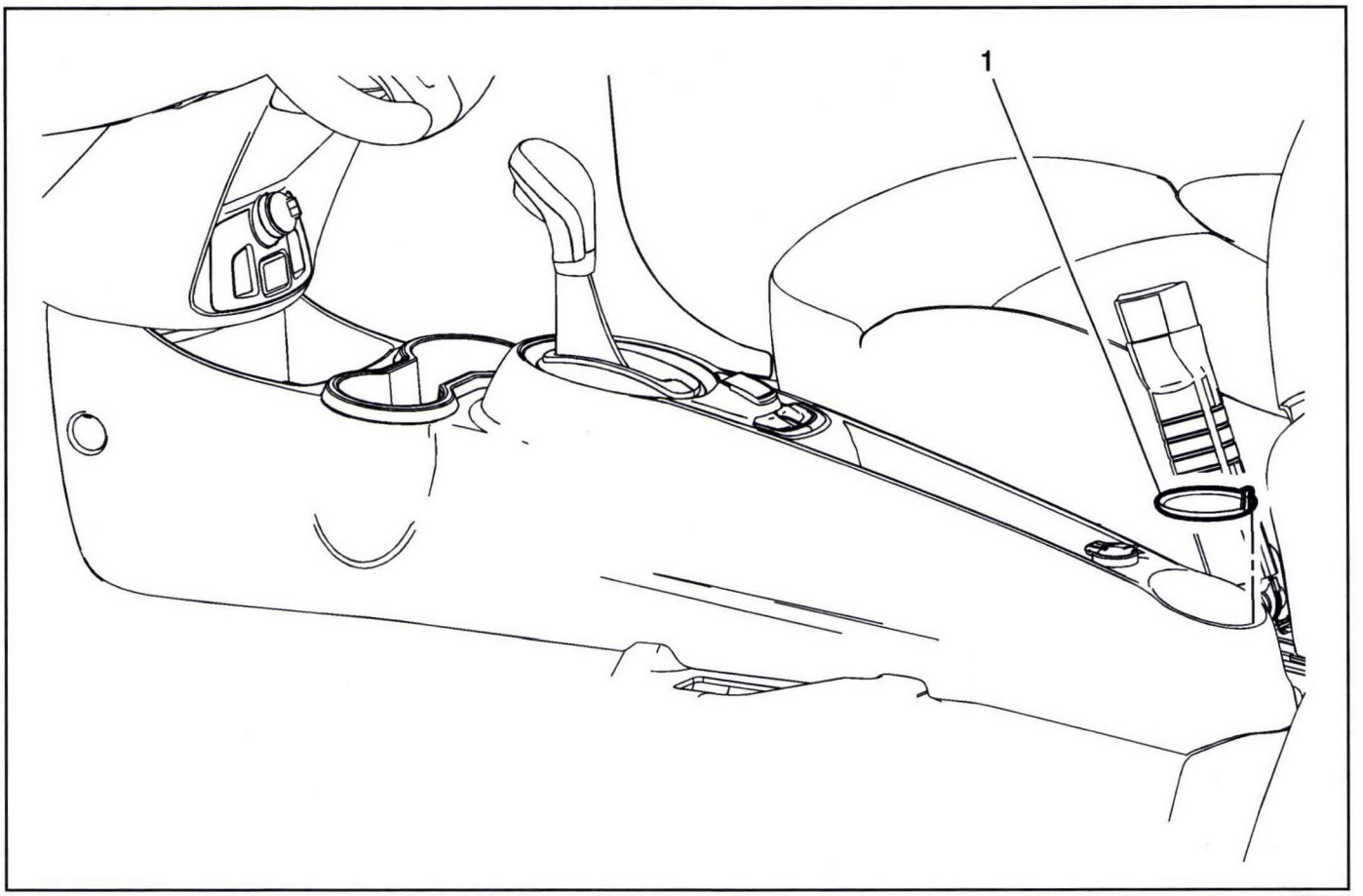


2968553

Front Floor Console Cup Holder Liner Replacement

Callout	Component Name
1	Front Floor Console Cup Holder Liner

Front Floor Console Rear Cup Holder Liner Replacement

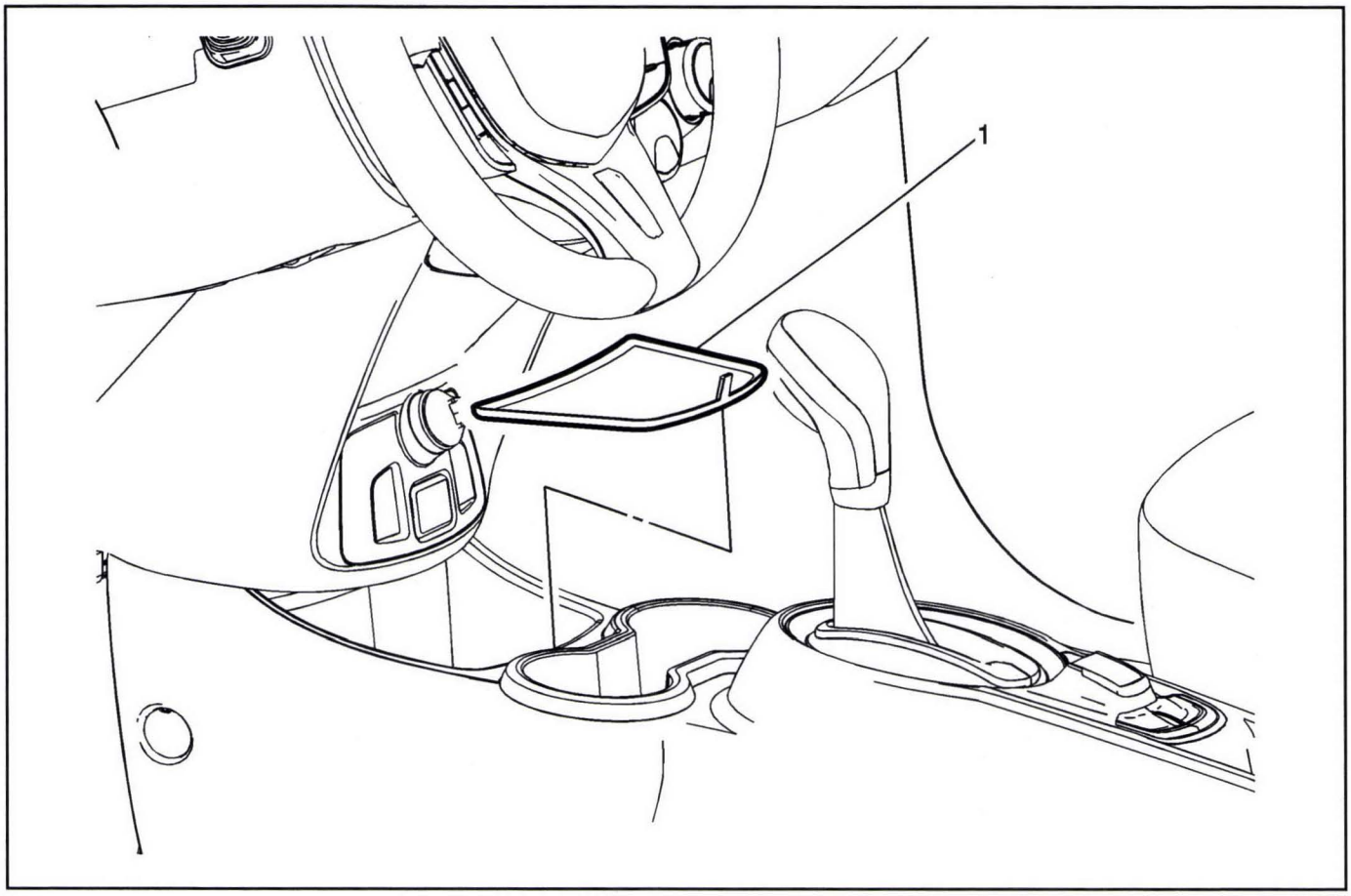


2968540

Front Floor Console Rear Cup Holder Liner Replacement

Callout	Component Name
1	Front Floor Console Rear Cup Holder Liner

Front Floor Console Compartment Liner Replacement

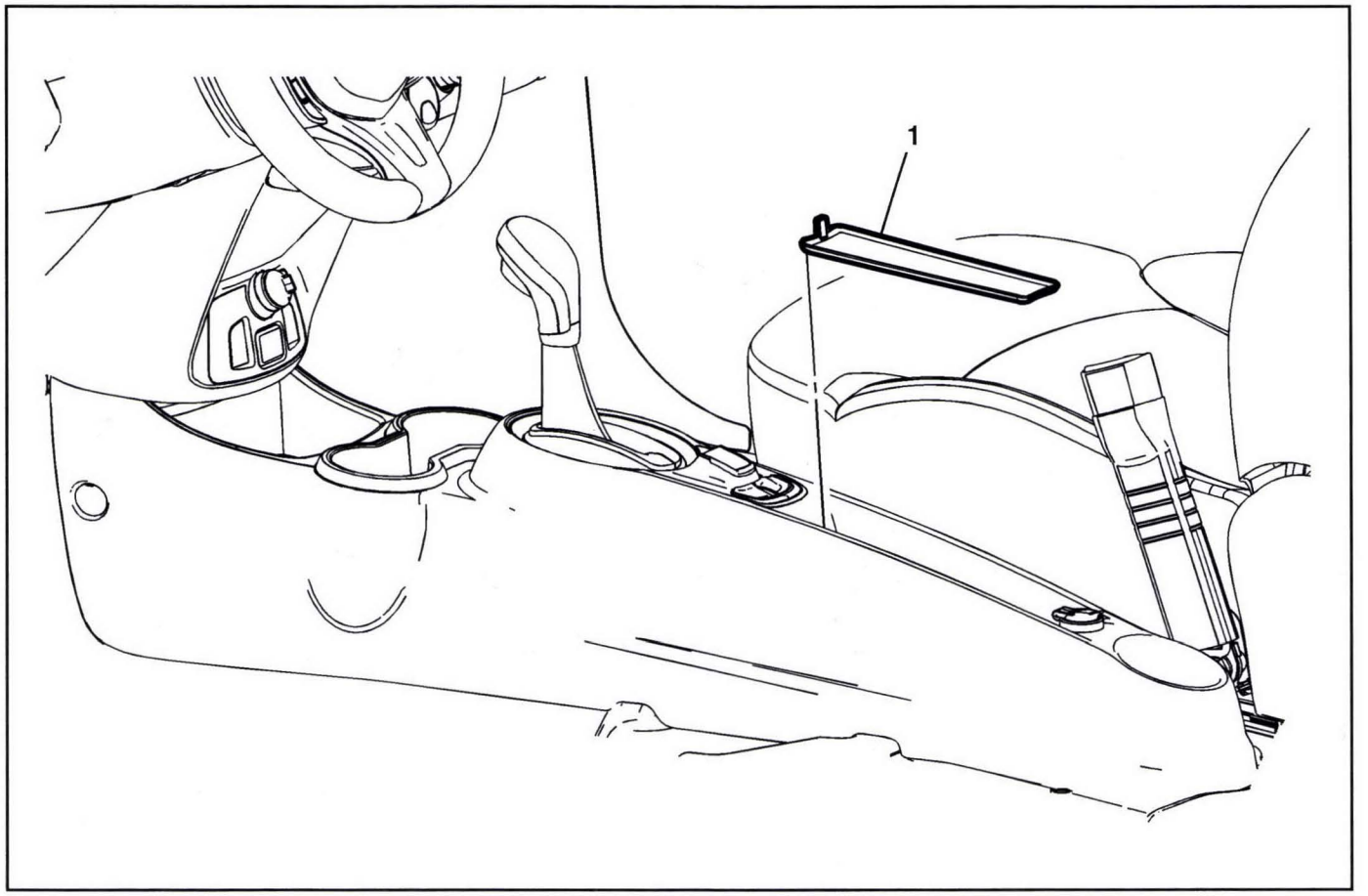


2968558

Front Floor Console Compartment Liner Replacement

Callout	Component Name
1	Front Floor Console Compartment Liner

Front Floor Console Center Compartment Liner Replacement

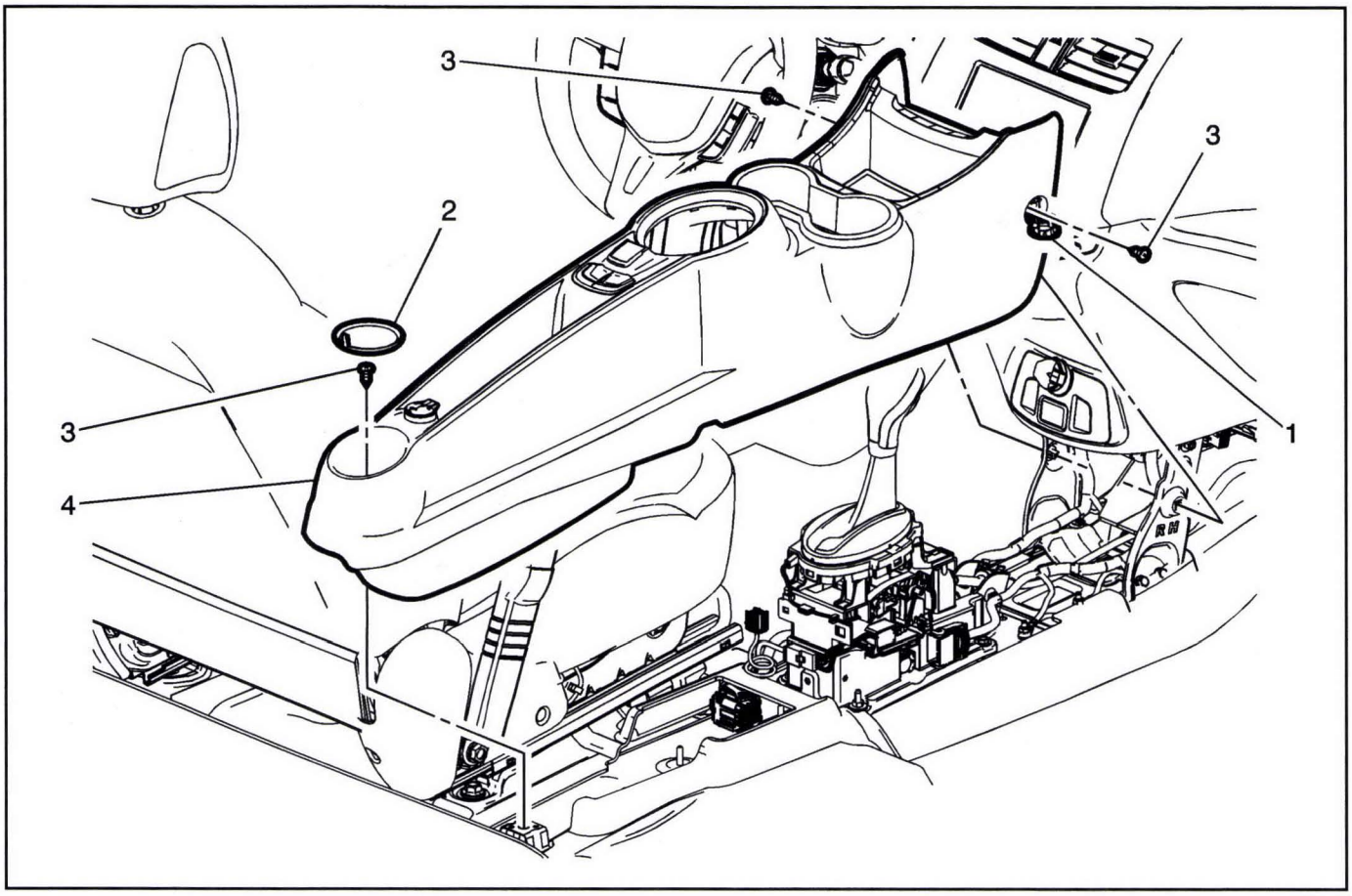


2968551

Front Floor Console Center Compartment Liner Replacement

Callout	Component Name
1	Front Floor Console Center Compartment Liner

Front Floor Console Replacement

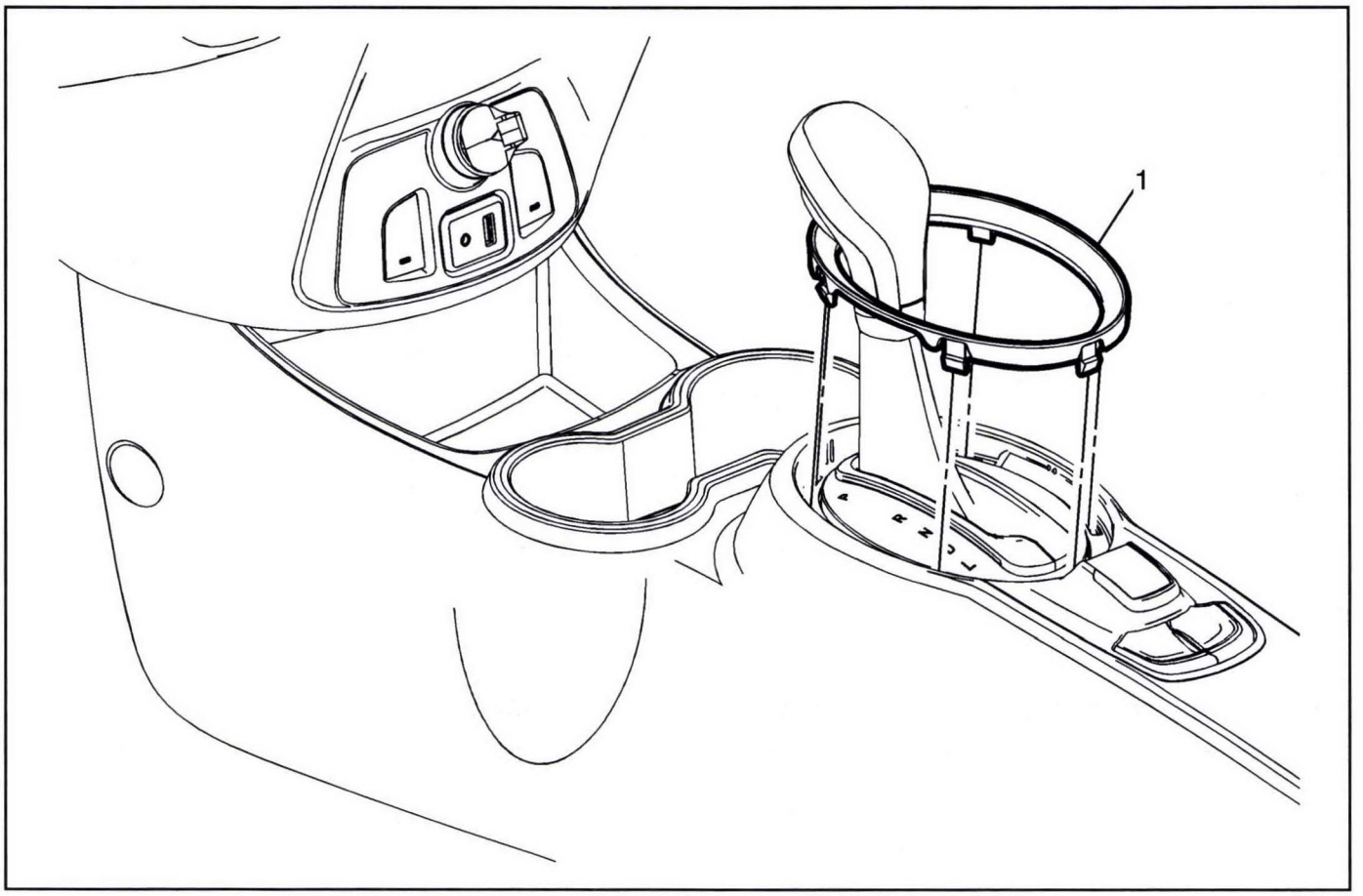


2968446

Front Floor Console Replacement

Callout	Component Name
Preliminary Procedure Set the parking brake and move the shiftier to neutral.	
1	Front Floor Console Bolt Access Hole Cover (Qty: 2) **Procedure** Use a flat-bladed plastic tool to release the cover from the front floor console assembly.
2	Front Floor Console Rear Cup Holder Liner
3	Front Floor Console Bolt (Qty: 3) **Caution:** Refer to *Fastener Caution on page 0-8*.
4	Front Floor Console **Procedure** 1. Disconnect electrical connections. 2. With the aid of an assistant lift the floor console rearward and upward away from the instrument panel assembly. 3. Transfer all necessary components.

Front Floor Console Front Cover Replacement



2968552

Front Floor Console Front Cover Replacement

Callout	Component Name
1	Front Floor Console Front Cover **Procedure** Use a suitable tool in order to release the tabs securing the front floor console front cover to the front floor console assembly.

Interior Trim and Paneling

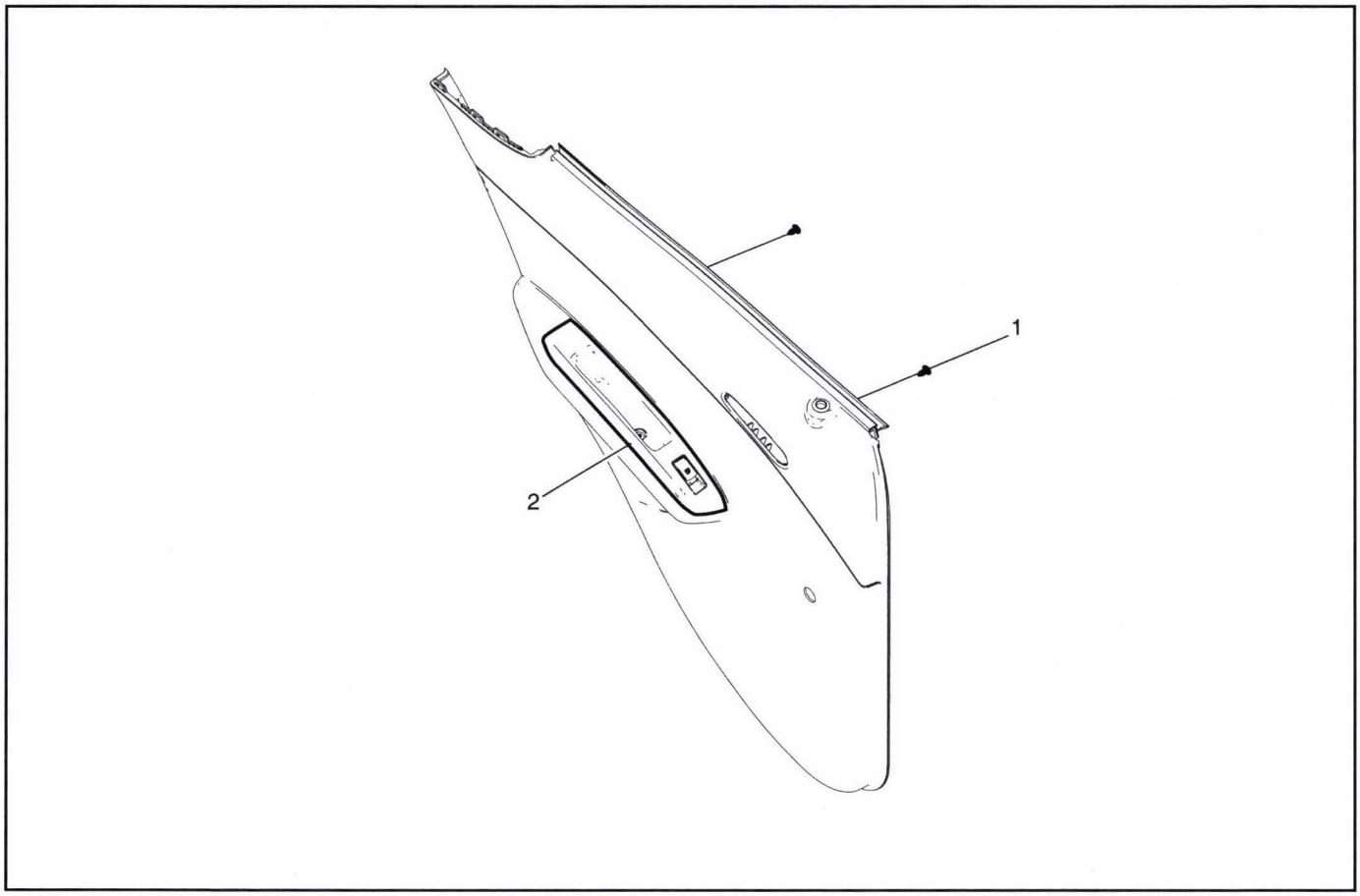
Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Assist Handle Bolt	5 N•m	44 lb in
Center Pillar Upper Trim Panel Screw	2 N•m	18 lb in
Front Side Door Window Switch Bezel Screw	2 N•m	18 lb in
Quarter Window Garnish Molding Screw	2 N•m	18 lb in
Rear Side Door Pull Handle Screw	2 N•m	18 lb in
Rear Side Door Window Switch Bezel Screw	2 N•m	18 lb in
Sunshade Screw	2 N•m	18 lb in
Sunshade Support Screw	2 N•m	18 lb in

Repair Instructions

Rear Side Door Window Switch Bezel Replacement

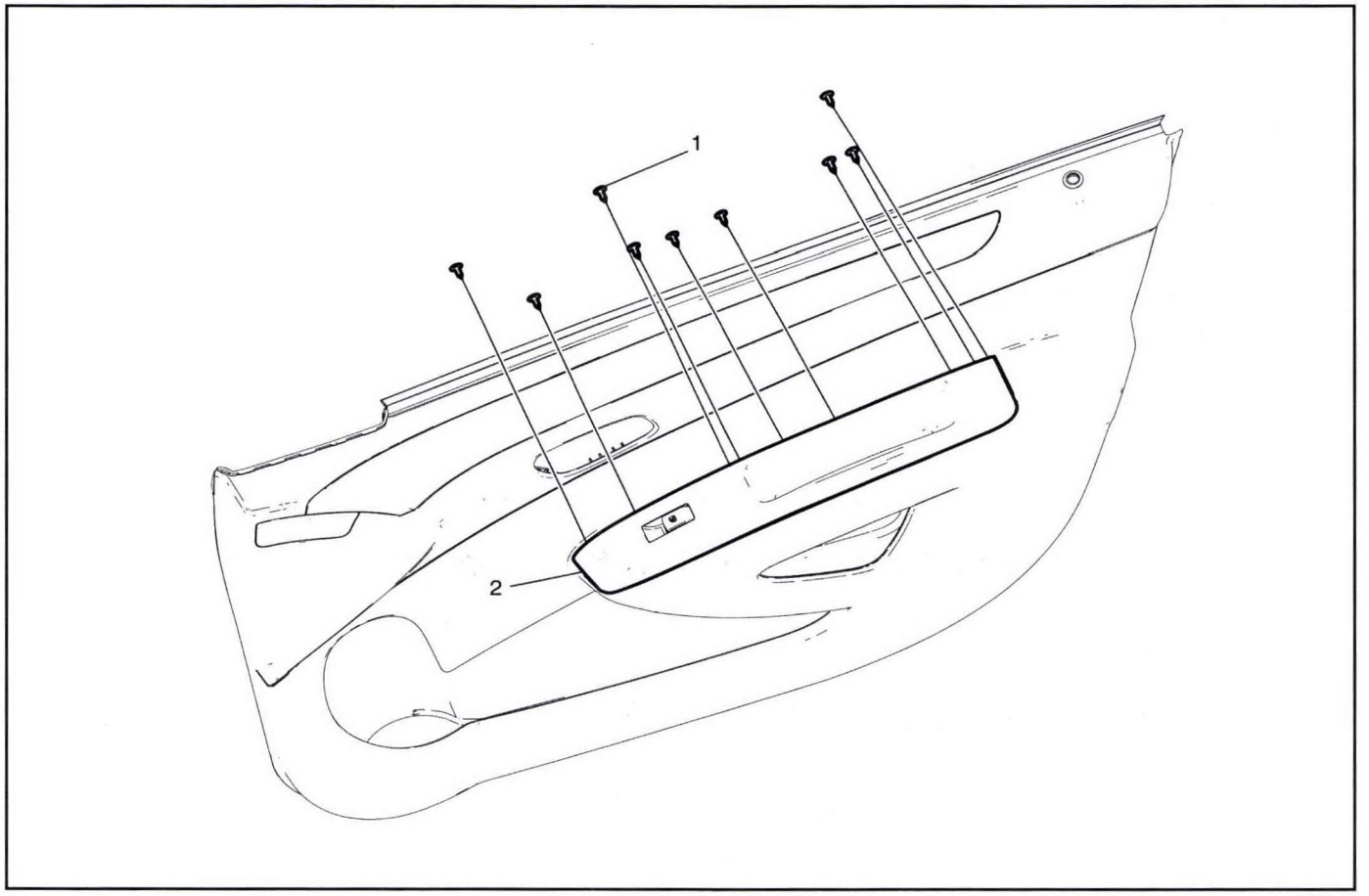


2309144

Rear Side Door Window Switch Bezel Replacement

Callout	Component Name
Preliminary Procedure Remove the rear side door trim. Refer to *Rear Side Door Trim Replacement on page 2-68*.	
1	Rear Side Door Window Switch Bezel Screw (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 2 N•m (18 lb in)
2	Rear Side Door Window Switch Bezel Assembly

Front Side Door Armrest Switch Mount Plate Replacement

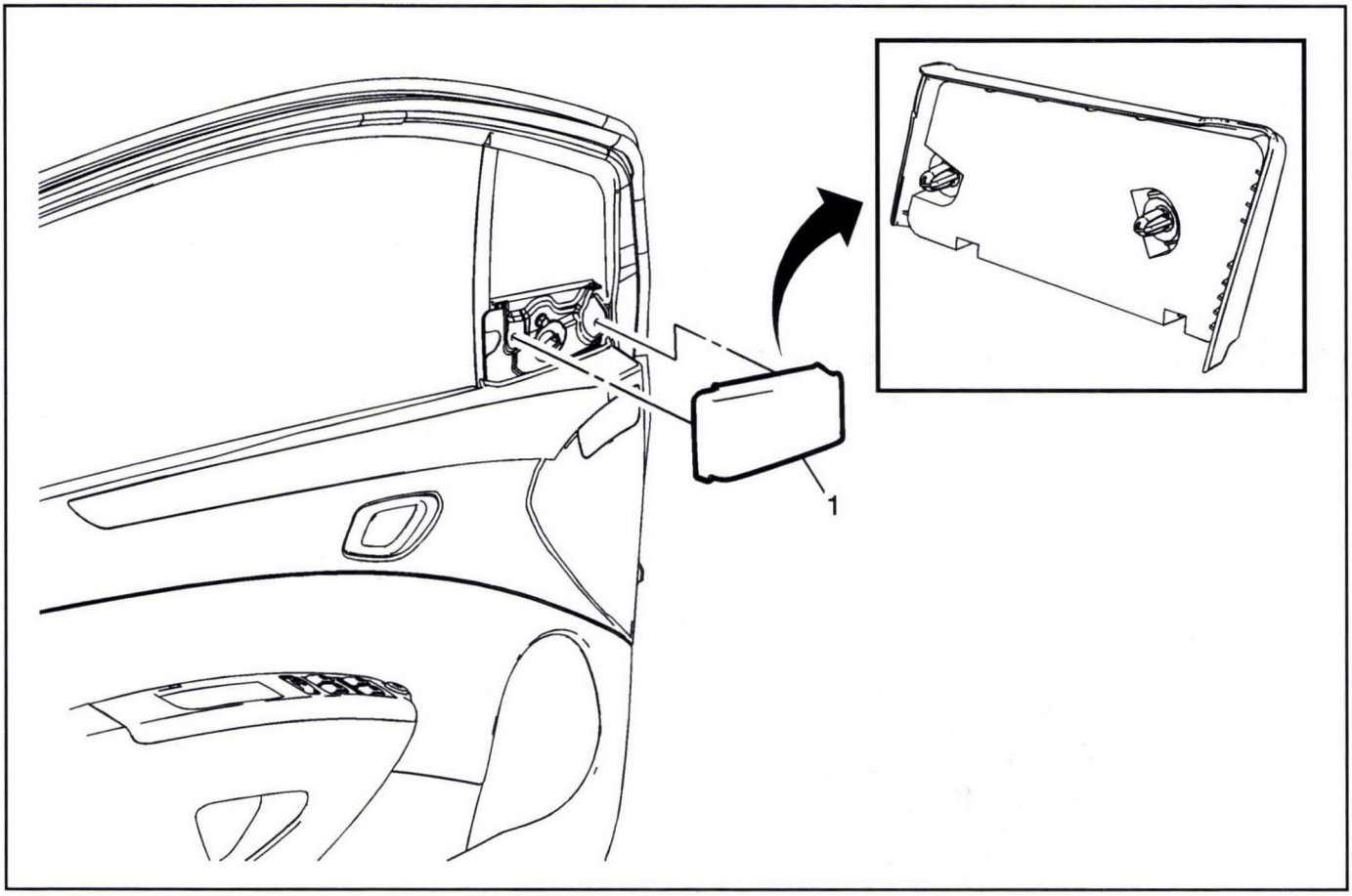


2309141

Front Side Door Armrest Switch Mount Plate Replacement

Callout	Component Name
Preliminary Procedure Remove the front side door trim. Refer to *Front Side Door Trim Replacement on page 2-53*.	
1	Front Side Door Armrest Switch Mount Plate Fastener (Qty: 9) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Front Side Door Armrest Switch Mount Plate Assembly

Front Side Door Upper Trim Panel Replacement

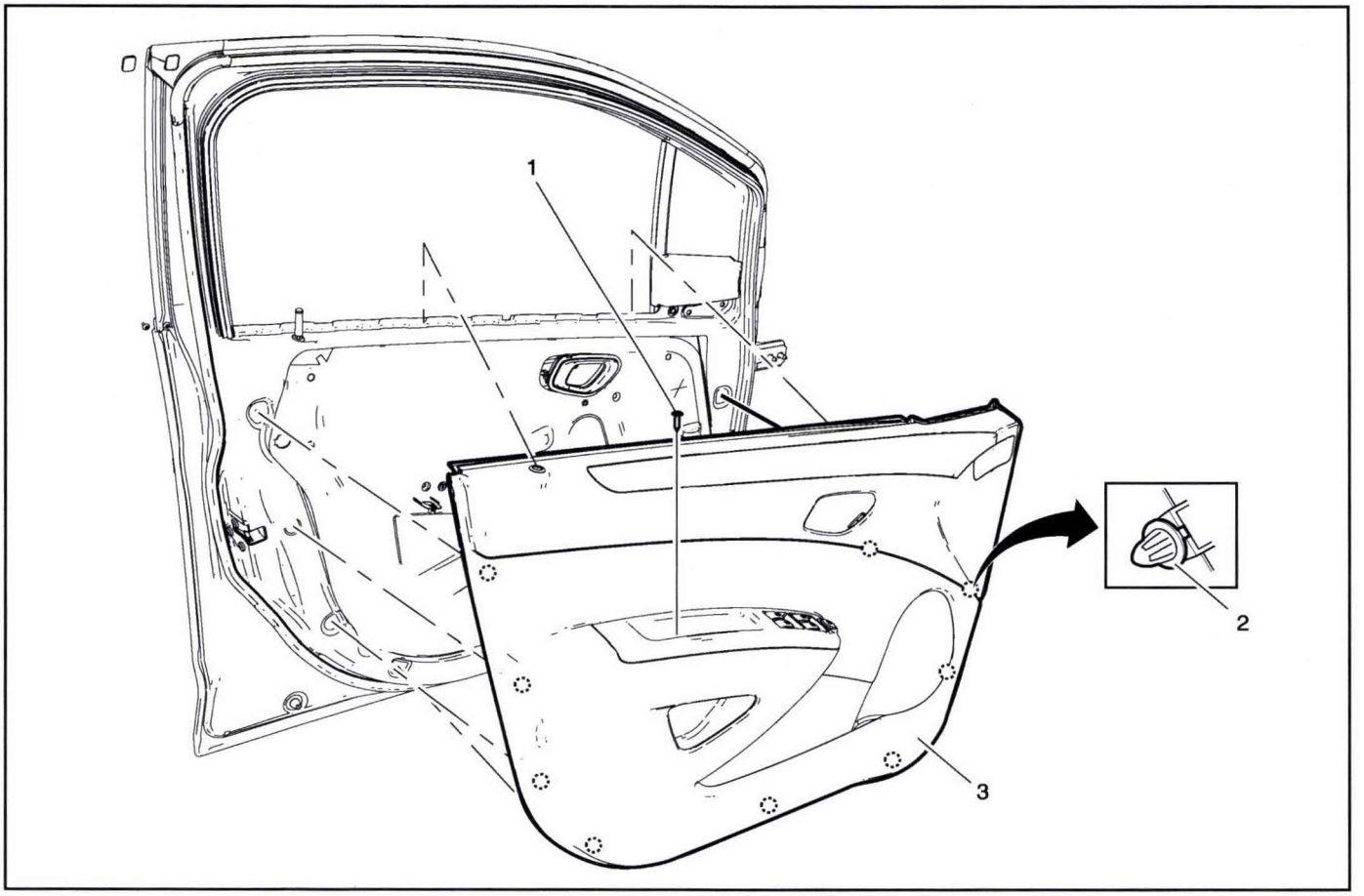


3032891

Front Side Door Upper Trim Panel Replacement

Callout	Component Name
1	Front Side Door Upper Trim Panel Assembly **Procedure** Pull the door upper trim panel away from the front side door.

Front Side Door Trim Replacement

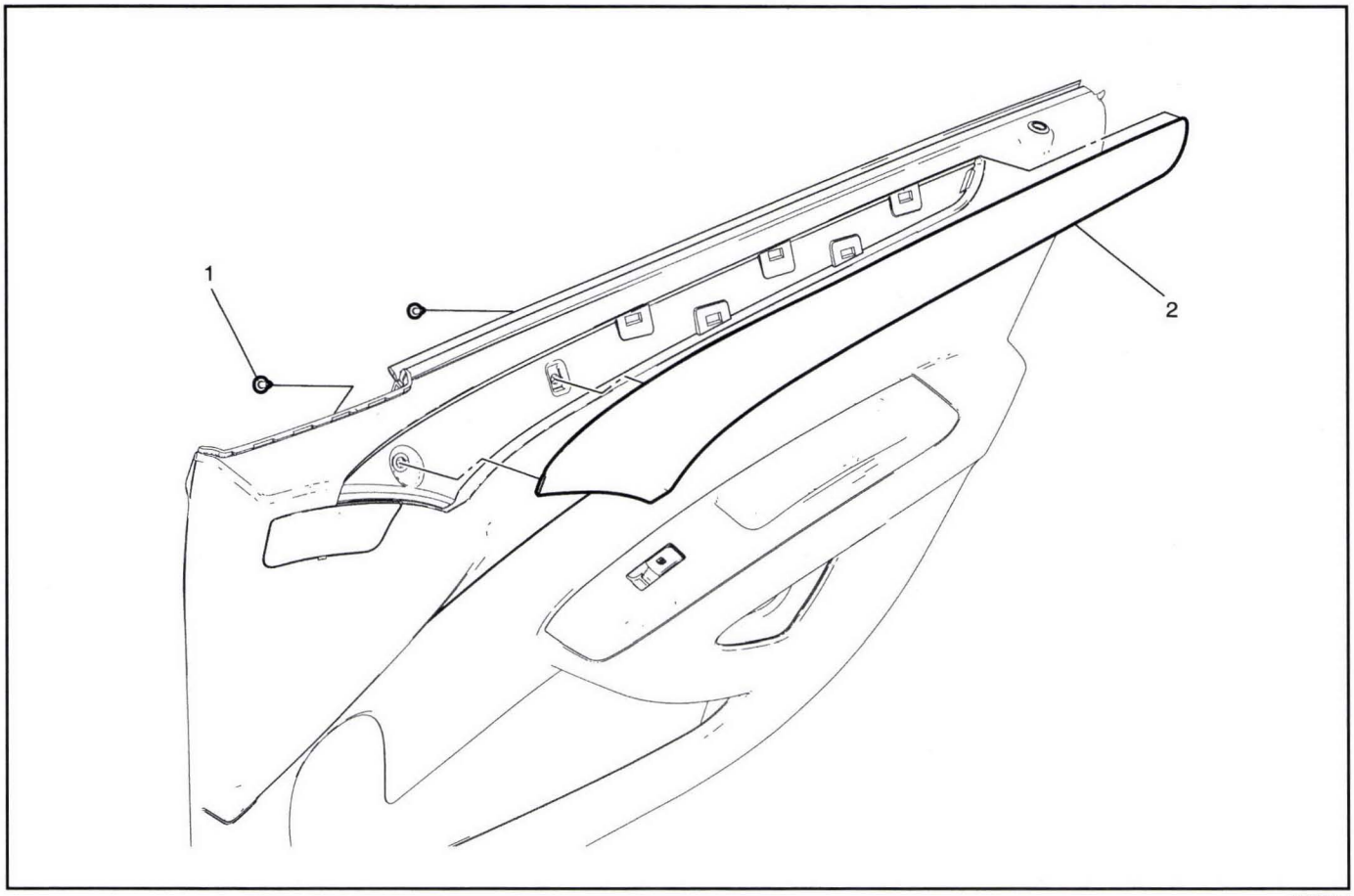


2309214

Front Side Door Trim Replacement

Callout	Component Name
Preliminary Procedure Remove the front side door upper trim panel. Refer to *Front Side Door Upper Trim Panel Replacement on page 2-52*.	
1	Front Side Door Pull Handle Fastener **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Front Side Door Trim Clip (Qty: 9)
3	Front Side Door Trim Assembly **Procedure** Disconnect the electrical connectors.

Front Side Door Trim Panel Applique Replacement

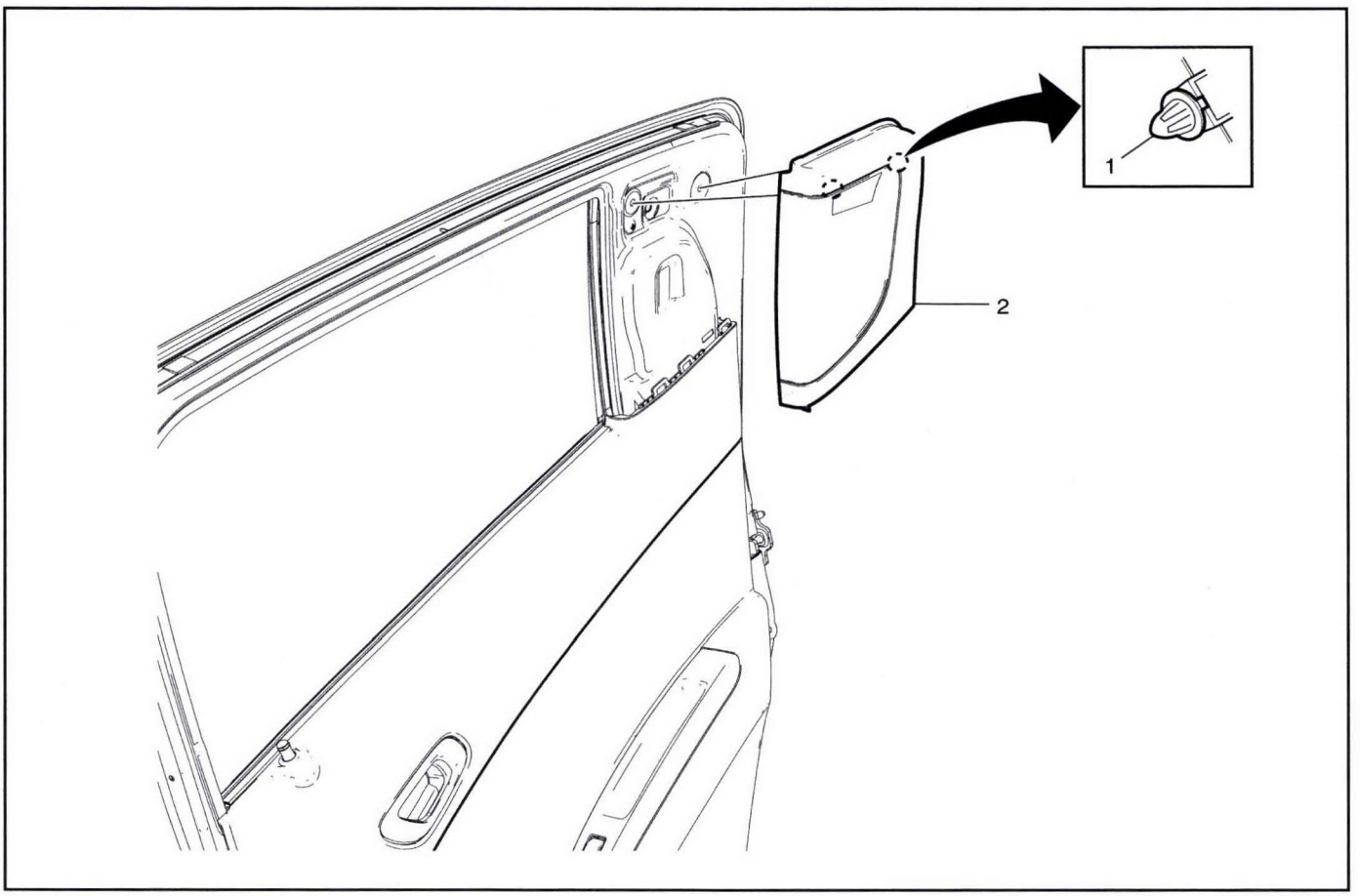


2309216

Front Side Door Trim Panel Applique Replacement

Preliminary Procedure Remove the front side door trim. Refer to *Front Side Door Trim Replacement on page 2-53*.	
1	Front Side Door Trim Panel Applique Screw (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Front Side Door Trim Panel Applique Assembly

Rear Side Door Upper Rear Trim Panel Replacement

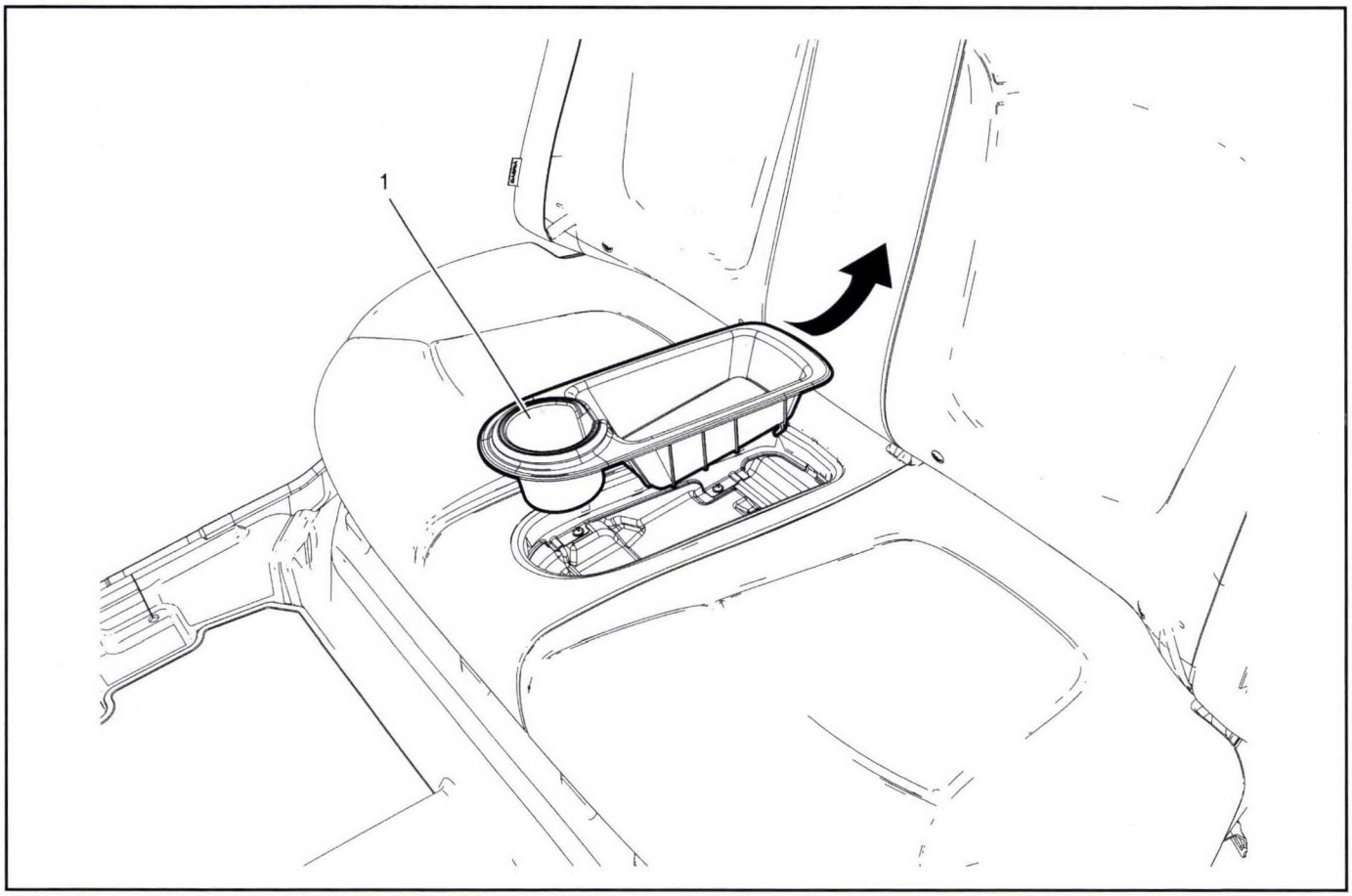


2309244

Rear Side Door Upper Rear Trim Panel Replacement

Callout	Component Name
1	Rear Side Door Upper Rear Trim Panel Clip (Qty: 2)
2	Rear Side Door Upper Rear Trim Panel Assembly **Procedure** Pull the door upper rear trim panel away from the rear side door.

Rear Seat Cup Holder Replacement

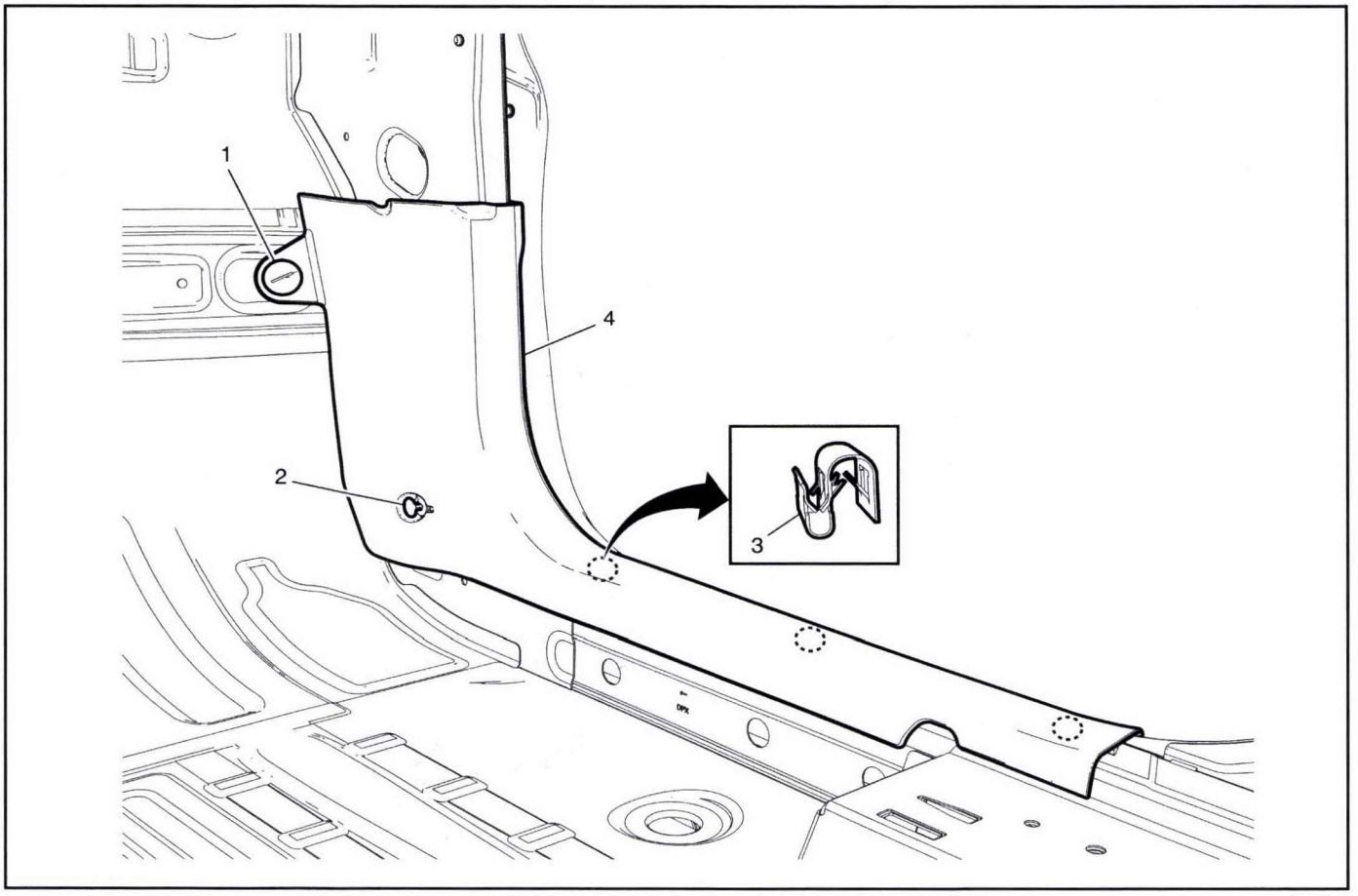


2754243

Rear Seat Cup Holder Replacement

Callout	Component Name
1	Rear Seat Cup Holder **Procedure** 1. Using flat-bladed tool, pull the rear portion of the rear seat cup holder up. 2. Remove the cup holder following the arrow.

Front Side Door Sill Garnish Molding Replacement

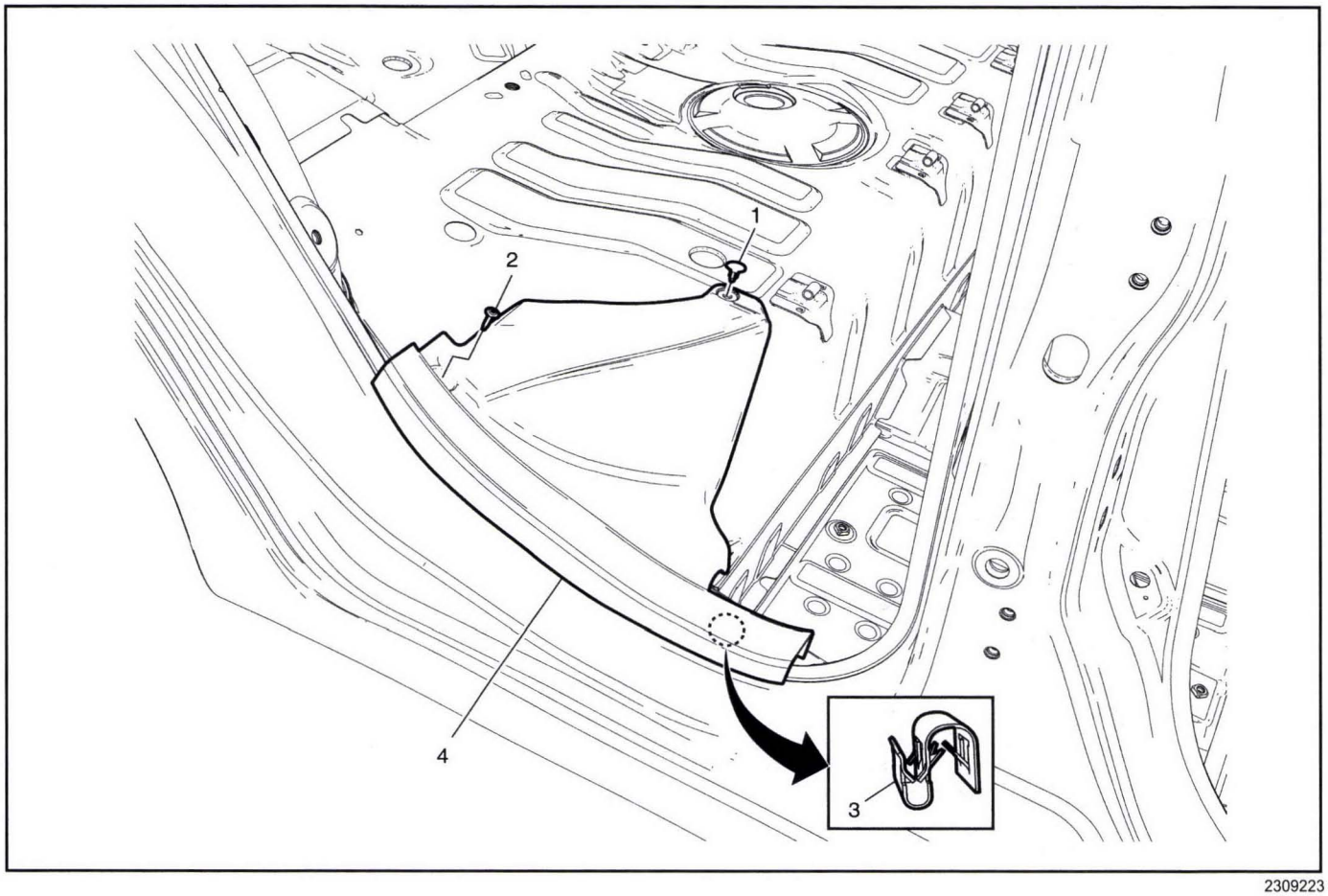


2309218

Front Side Door Sill Garnish Molding Replacement

Callout	Component Name
1	Body Hinge Pillar Trim Panel Retainer
2	Front Side Door Sill Trim Plate Push Pin Clip
3	Front Side Door Sill Trim Plate Clip (Qty: 4)
4	Front Side Door Sill Garnish Molding Assembly

Rear Side Door Sill Garnish Molding Replacement

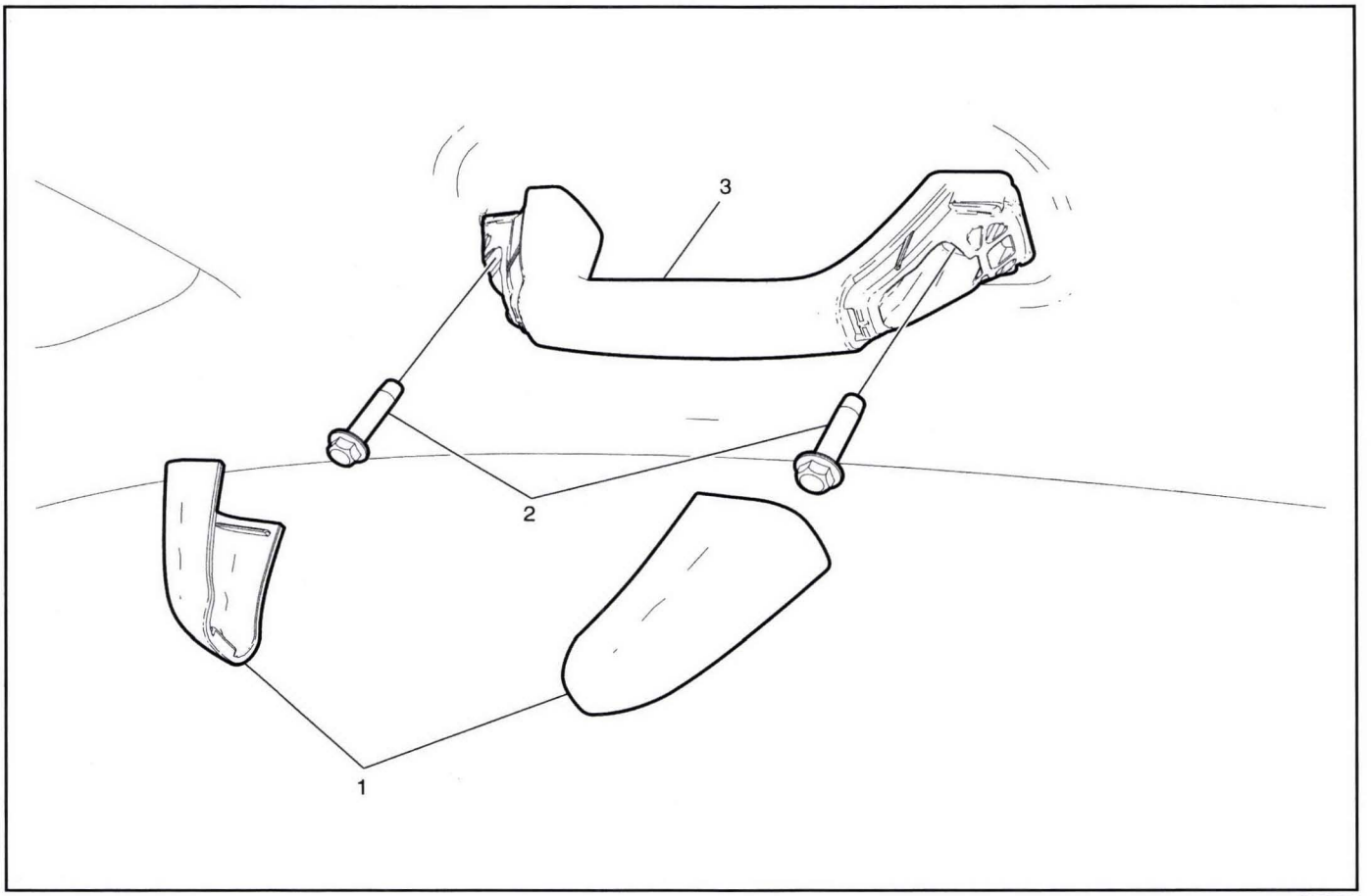


2309223

Rear Side Door Sill Garnish Molding Replacement

Callout	Component Name
Preliminary Procedure Remove the rear seat cushion. Refer to *Rear Seat Cushion Removal and Installation on page 13-21*.	
1	Rear Side Door Sill Trim Plate Push Clip
2	Rear Side Door Sill Garnish Molding Fastener **Caution:** Refer to *Fastener Caution on page 0-8*.
3	Rear Side Door Sill Trim Plate Clip
4	Rear Side Door Sill Garnish Molding Assembly

Assist Handle Replacement

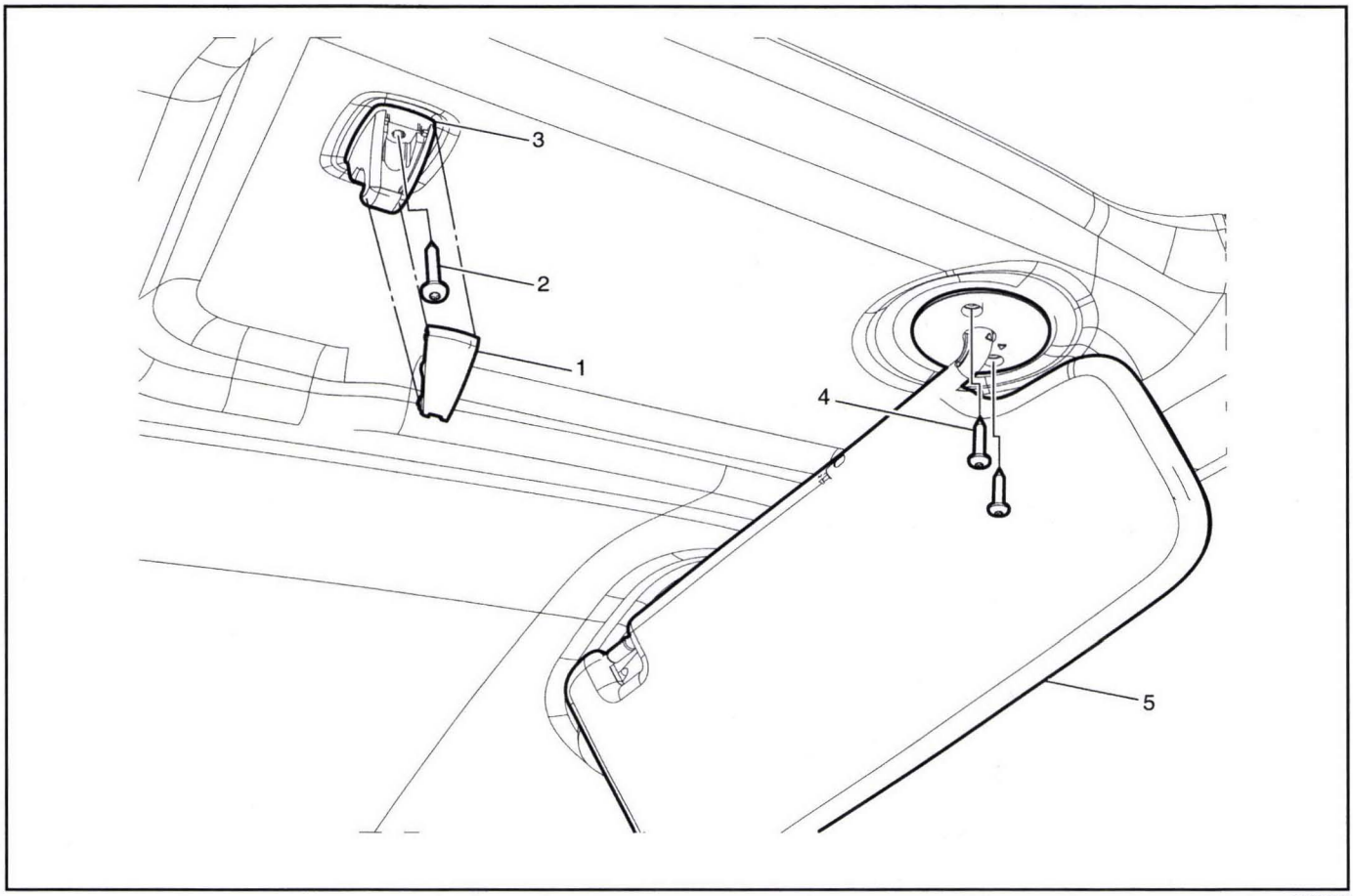


2309227

Assist Handle Replacement

Callout	Component Name
1	Assist Handle Bolt Cover
2	Assist Handle Bolt (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 5 N•m (44 lb in)
3	Assist Handle Assembly

Sunshade Replacement

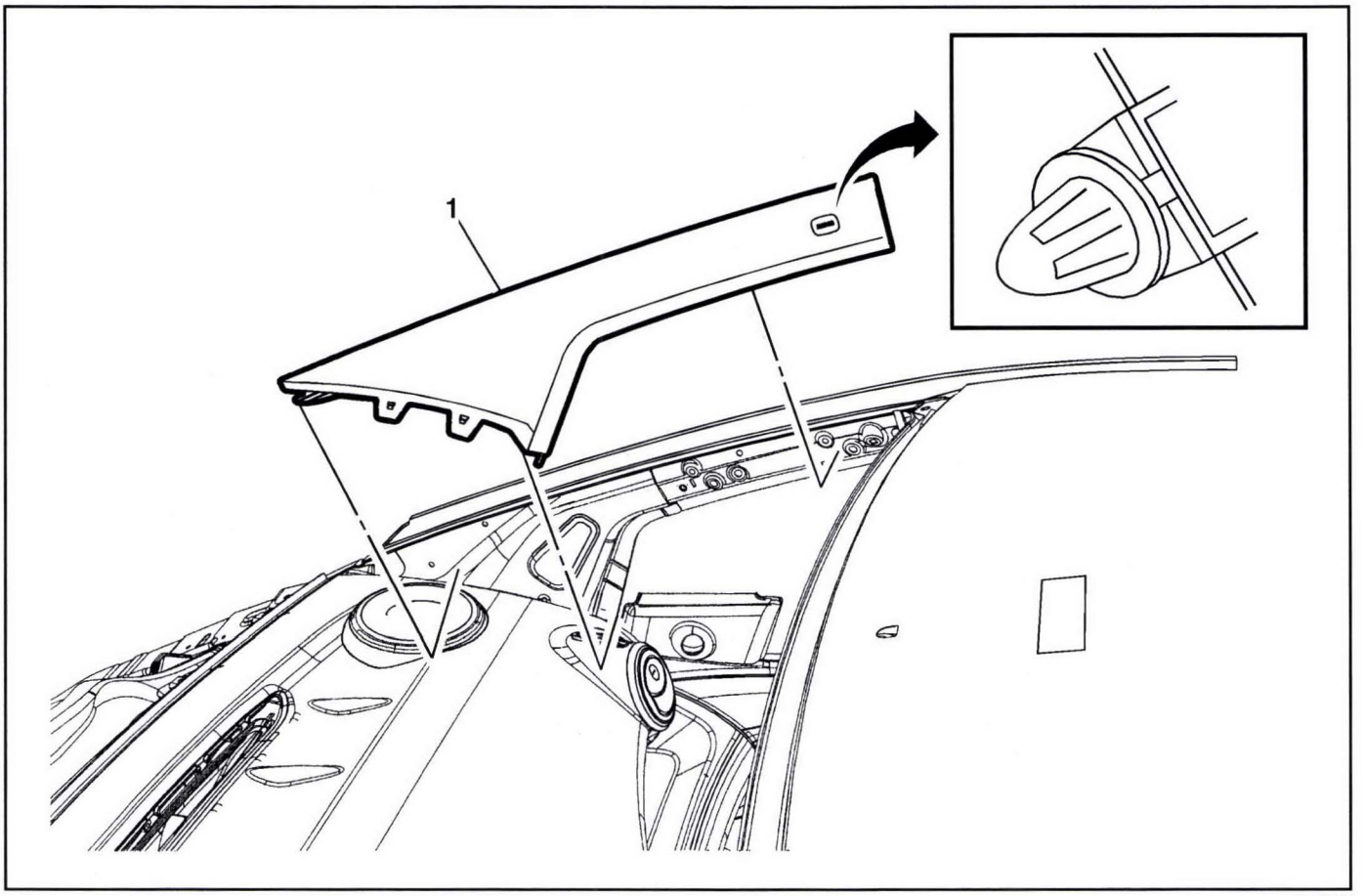


2309228

Sunshade Replacement

Callout	Component Name
1	Sunshade Support Screw Cover
2	Sunshade Support Screw (Qty: 1) **Caution:** Refer to *Fastener Caution on page 0-8* **Tighten** 2 N•m (18 lb in)
3	Sunshade Support
4	Sunshade Screw (Qty: 2) **Tighten** 2 N•m (18 lb in)
5	Sunshade Assembly

Windshield Garnish Molding Replacement

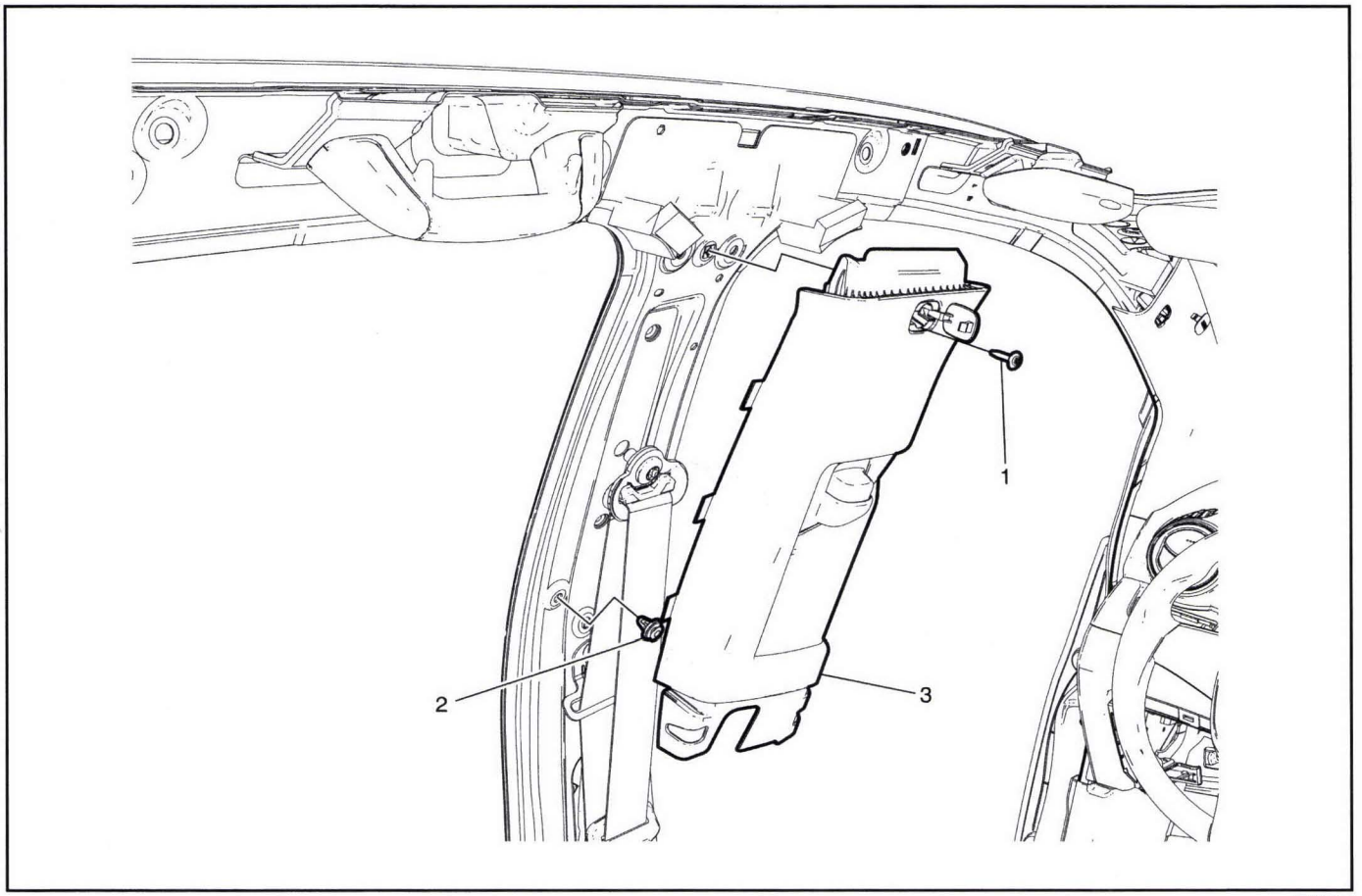


3136411

Windshield Garnish Molding Replacement

Callout	Component Name
Preliminary Procedure Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.	
1	Windshield Garnish Molding Assembly **Procedure** 1. Tabs must be installed prior to retainers. 2. Tabs to be fully seated in the instrument panel (I/P) trim pad. 3. Ensure the tether is reattached when installed.

Center Pillar Upper Trim Panel Replacement

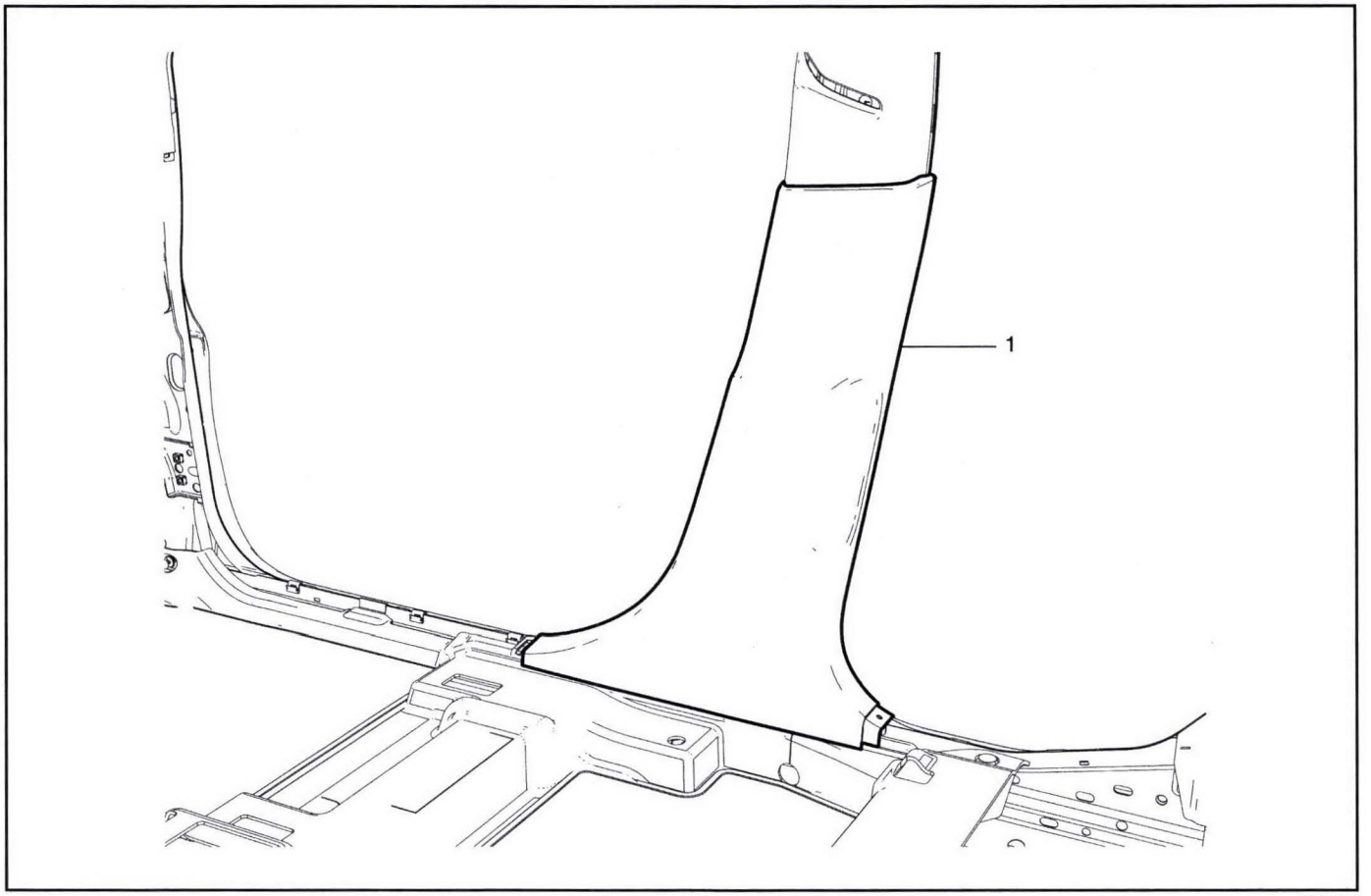


2309232

Center Pillar Upper Trim Panel Replacement

Callout	Component Name
Preliminary Procedure 1. Remove the center pillar lower trim panel. Refer to *Center Pillar Lower Trim Panel Replacement on page 2-63*. 2. Remove the seat belt lower bolt. Refer to *Driver or Passenger Seat Retractor Side Belt Replacement on page 12-171*.	
1	Center Pillar Upper Trim Panel Screw **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 2 N•m (18 lb in)
2	Center Pillar Upper Trim Panel Clip
3	Center Pillar Upper Trim Panel Assembly **Procedure** When replacing the center pillar upper trim panel, remove the seat belt through the panel.

Center Pillar Lower Trim Panel Replacement

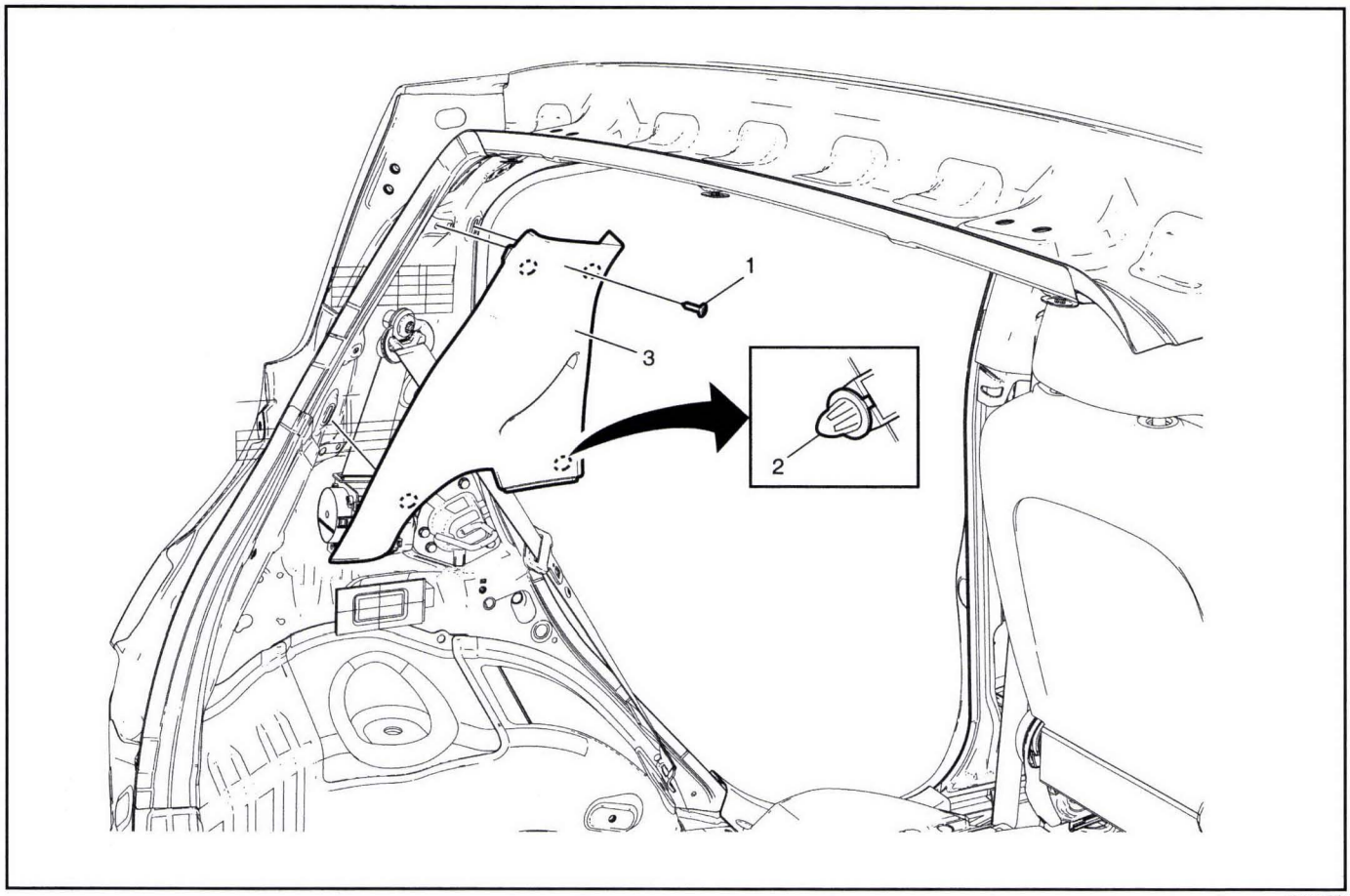


2309236

Center Pillar Lower Trim Panel Replacement

Callout	Component Name
Preliminary Procedure 1. Remove the front side door sill garnish molding. Refer to *Front Side Door Sill Garnish Molding Replacement on page 2-57*. 2. Remove the rear side door sill garnish molding. Refer to *Rear Side Door Sill Garnish Molding Replacement on page 2-58*.	
1	Center Pillar Lower Trim Panel Assembly

Quarter Window Trim Finish Panel Replacement

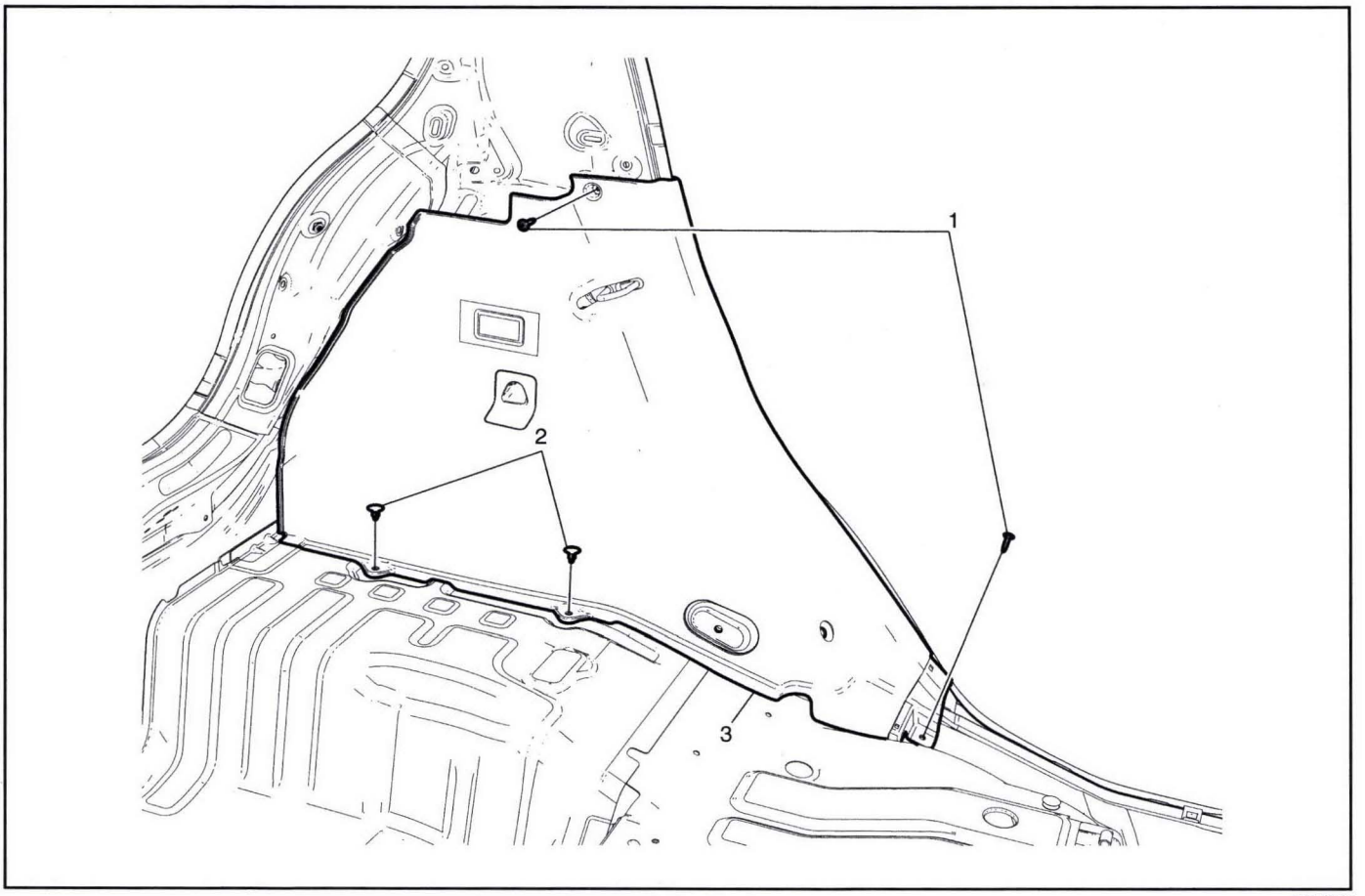


2309239

Quarter Window Trim Finish Panel Replacement

Callout	Component Name
Preliminary Procedure Remove the rear window panel stowage compartment cover. Refer to *Rear Window Panel Stowage Compartment Cover Replacement on page 2-66*.	
1	Quarter Window Garnish Molding Screw (Qty: 1) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 2 N•m (18 lb in)
2	Quarter Window Garnish Molding Clip (Qty: 4)
3	Quarter Window Garnish Molding Assembly

Quarter Lower Rear Trim Panel Replacement

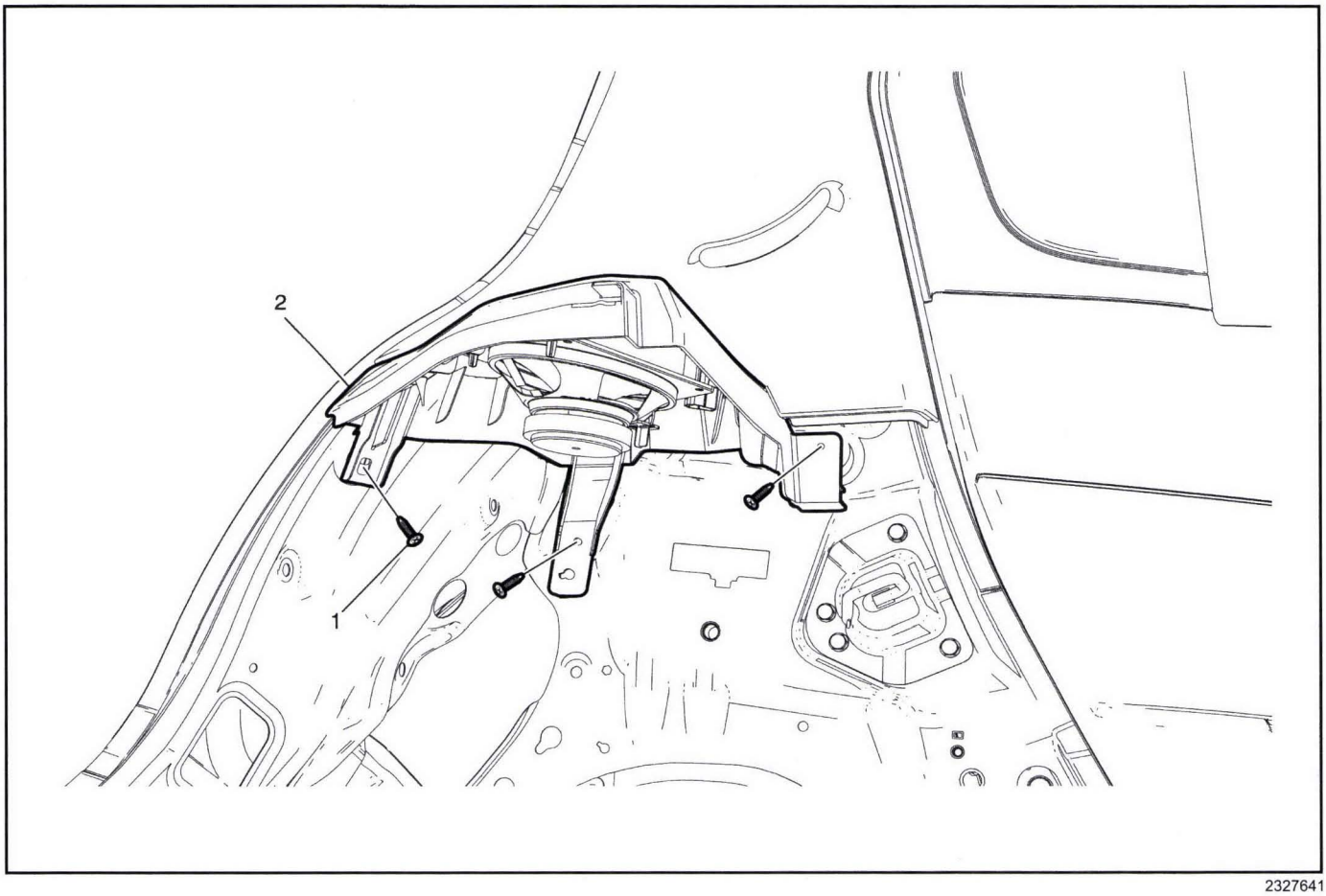


2309225

Quarter Lower Rear Trim Panel Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the rear side door sill garnish molding. Refer to *Rear Side Door Sill Garnish Molding Replacement on page 2-58*. 2. Remove the rear seat back cushion. Refer to *Rear Seat Back Cushion Removal and Installation (60 percent seat) on page 13-24* or *Rear Seat Back Cushion Removal and Installation (40 percent seat) on page 13-25*. 3. Remove the rear seat belt lower bolt. Refer to *Rear Seat Belt Retractor Replacement on page 12-97*.	
1	Rear Wheel House Trim Finish Panel Screw (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Rear Wheelhouse Trim Finish Panel Clip (Qty: 2)
3	Rear Wheelhouse Trim Finish Panel Assembly

Rear Window Panel Stowage Compartment Cover Replacement

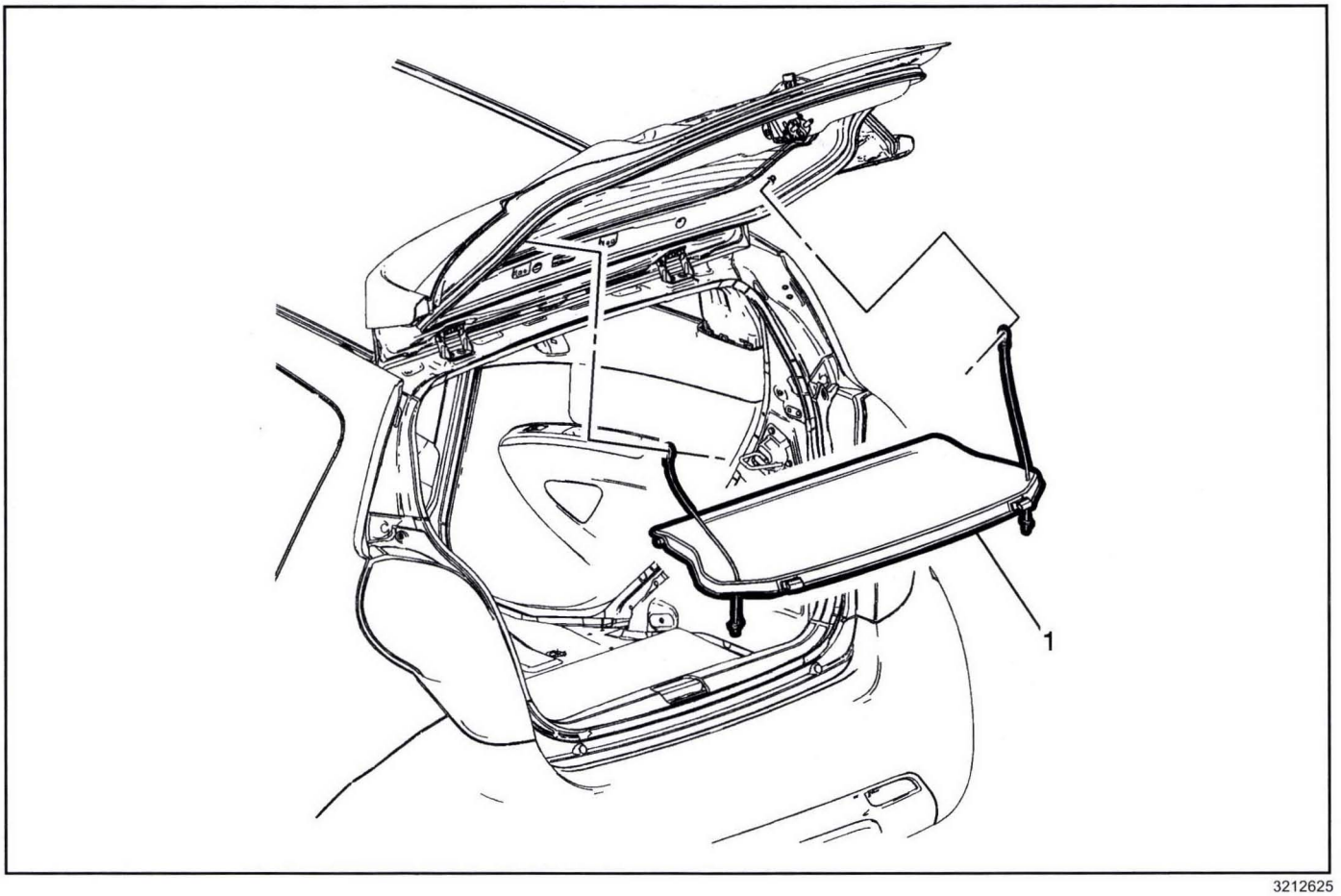


2327641

Rear Window Panel Stowage Compartment Cover Replacement

Callout	Component Name
Preliminary Procedure Remove the quarter lower rear trim panel. Refer to *Quarter Lower Rear Trim Panel Replacement on page 2-65*.	
1	Quarter Lower Rear Trim Panel Screw (Qty: 3) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Quarter Lower Rear Trim Panel **Note:** If necessary, disconnect the speaker electric wiring connector.

Rear Compartment Stowage Shelf Replacement



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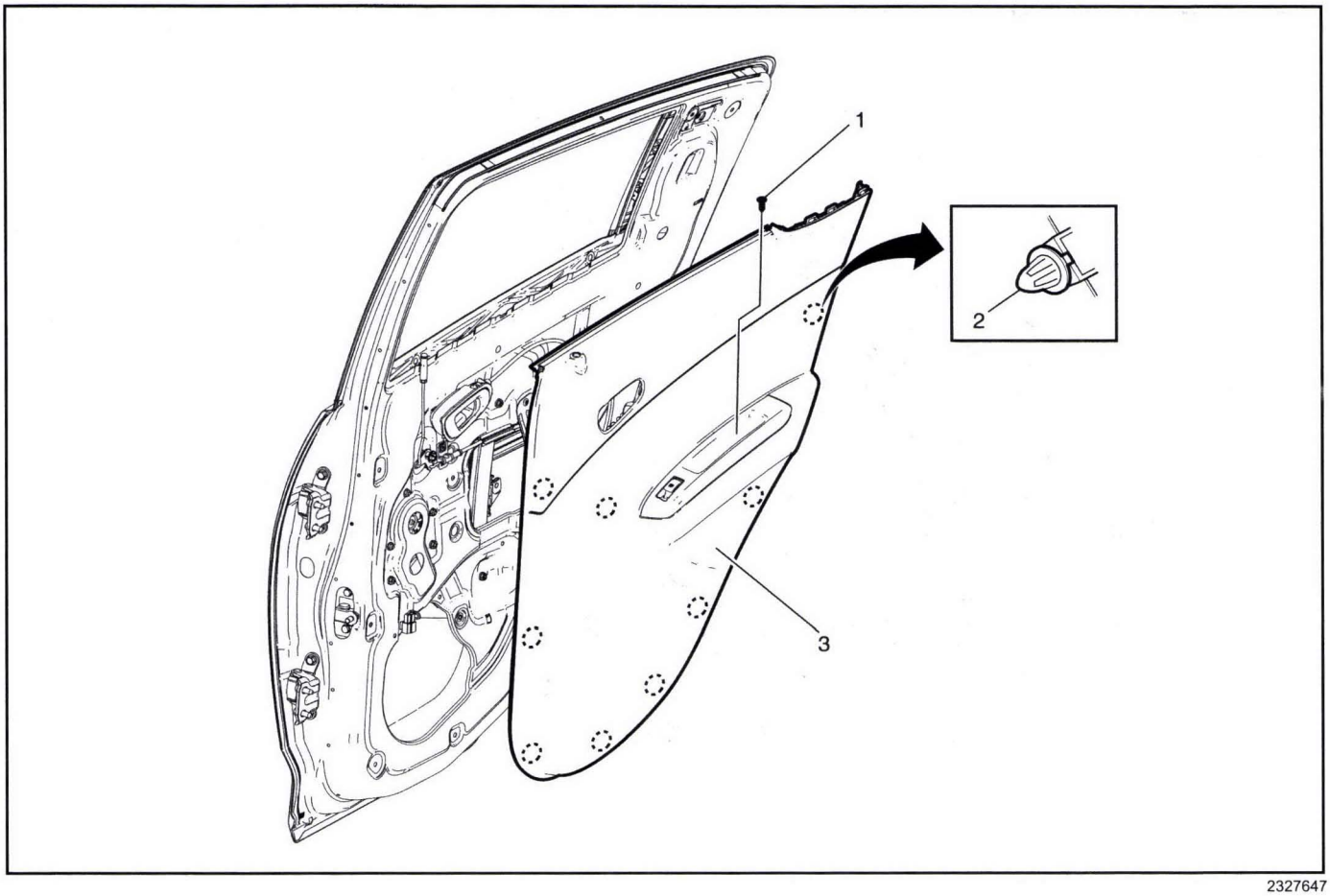
Rear Compartment Stowage Shelf Replacement

Callout	Component Name
1	Rear Compartment Stowage Shelf **Procedure** Detach rear compartment stowage shelf from upper supports.

Rear Side Door Trim Replacement



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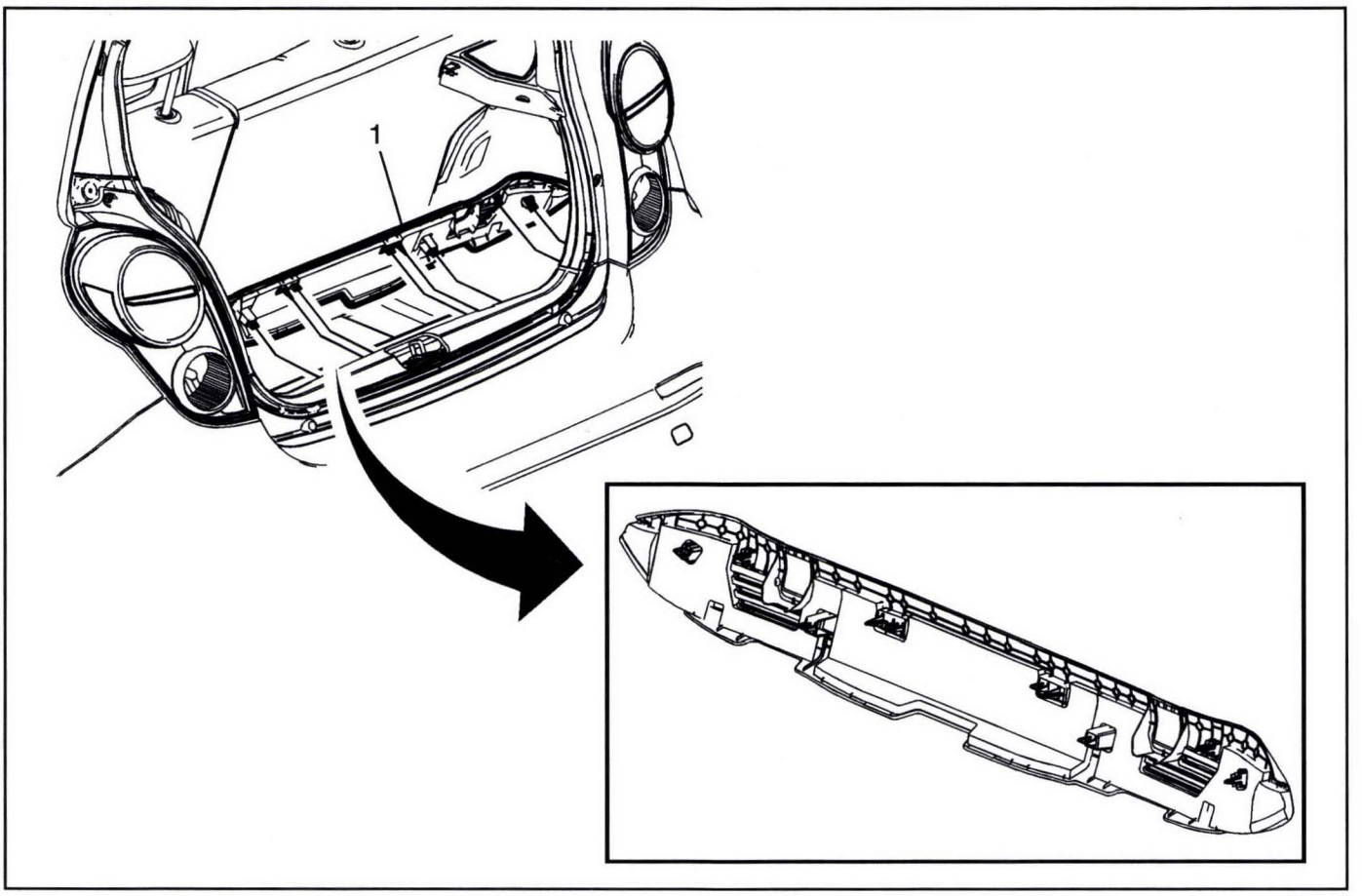
Rear Side Door Trim Replacement

Callout	Component Name
Preliminary Procedure Remove the rear side door upper rear trim panel. Refer to *Rear Side Door Upper Rear Trim Panel Replacement on page 2-55*.	
1	Rear Side Door Pull Handle Screw **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 2 N•m (18 lb in)
2	Rear Side Door Trim Clip (Qty: 9)
3	Rear Side Door Trim Assembly **Procedure** Disconnect the electrical connectors.

Liftgate Sill Garnish Molding Replacement



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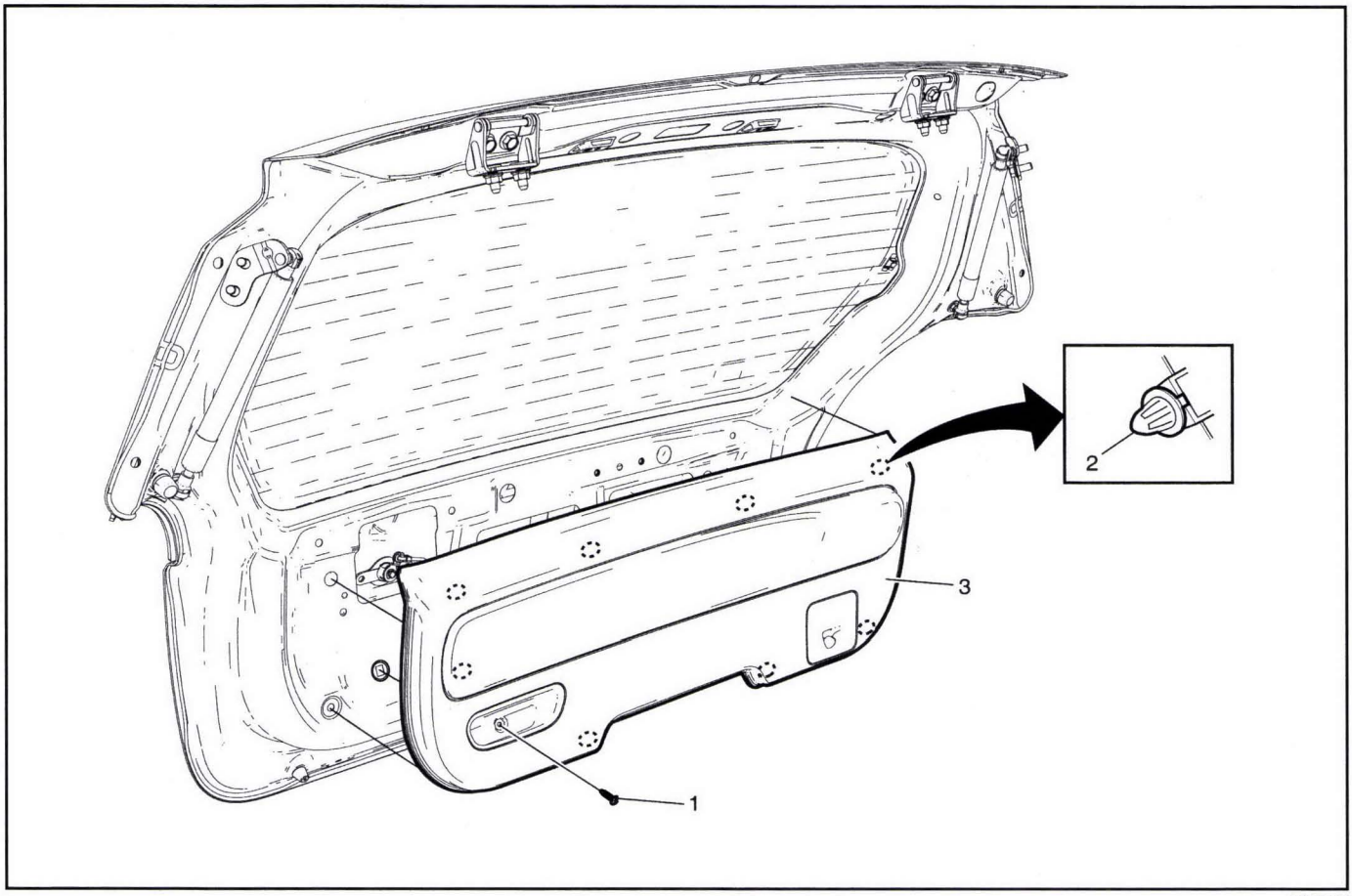
Liftgate Sill Garnish Molding Replacement

Callout	Component Name
1	Liftgate Sill Garnish Molding Assembly **Procedure** 1. Pull up and out on the liftgate sill garnish molding to disengage the locating pins and clips.

Liftgate Trim Finish Panel Replacement



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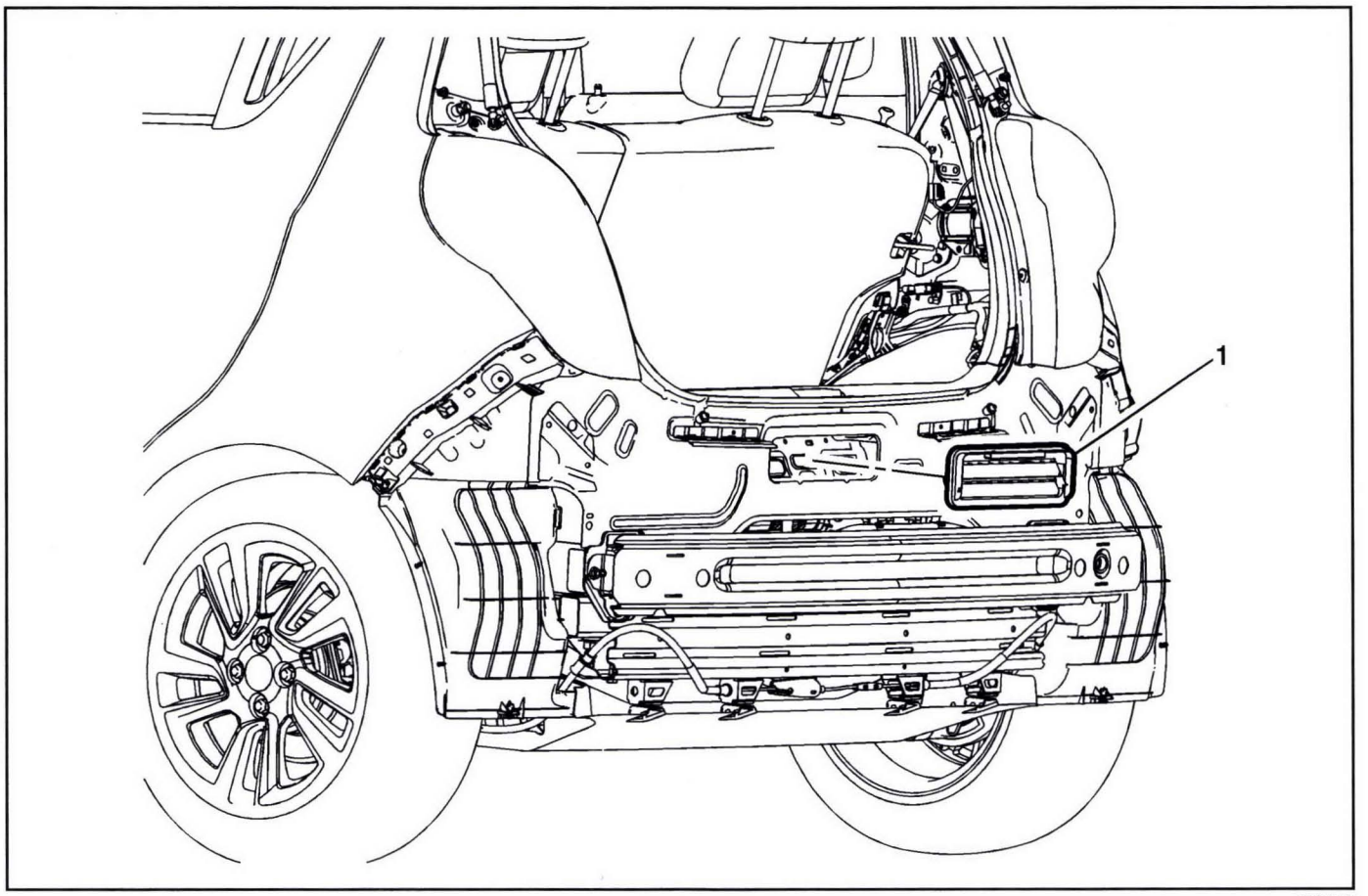
Liftgate Trim Finish Panel Replacement

Callout	Component Name
1	Liftgate Trim Finish Panel Fastener **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Liftgate Trim Finish Panel Clip (Qty: 8)
3	Liftgate Trim Finish Panel Assembly

Body Pressure Relief Valve Replacement



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Body Pressure Relief Valve Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the liftgate sill garnish molding. Refer to *Liftgate Sill Garnish Molding Replacement on page 2-69*. 2. Remove the rear bumper fascia. Refer to *Rear Bumper Fascia Replacement on page 3-63*.	
1	Body Pressure Relief Valve **Procedure** Release the tabs attaching the body pressure relief valve to the inner rear end lower panel to remove the body pressure relief valve.

BLANK

Section 3

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Bolted Exterior Body Panels and Closures

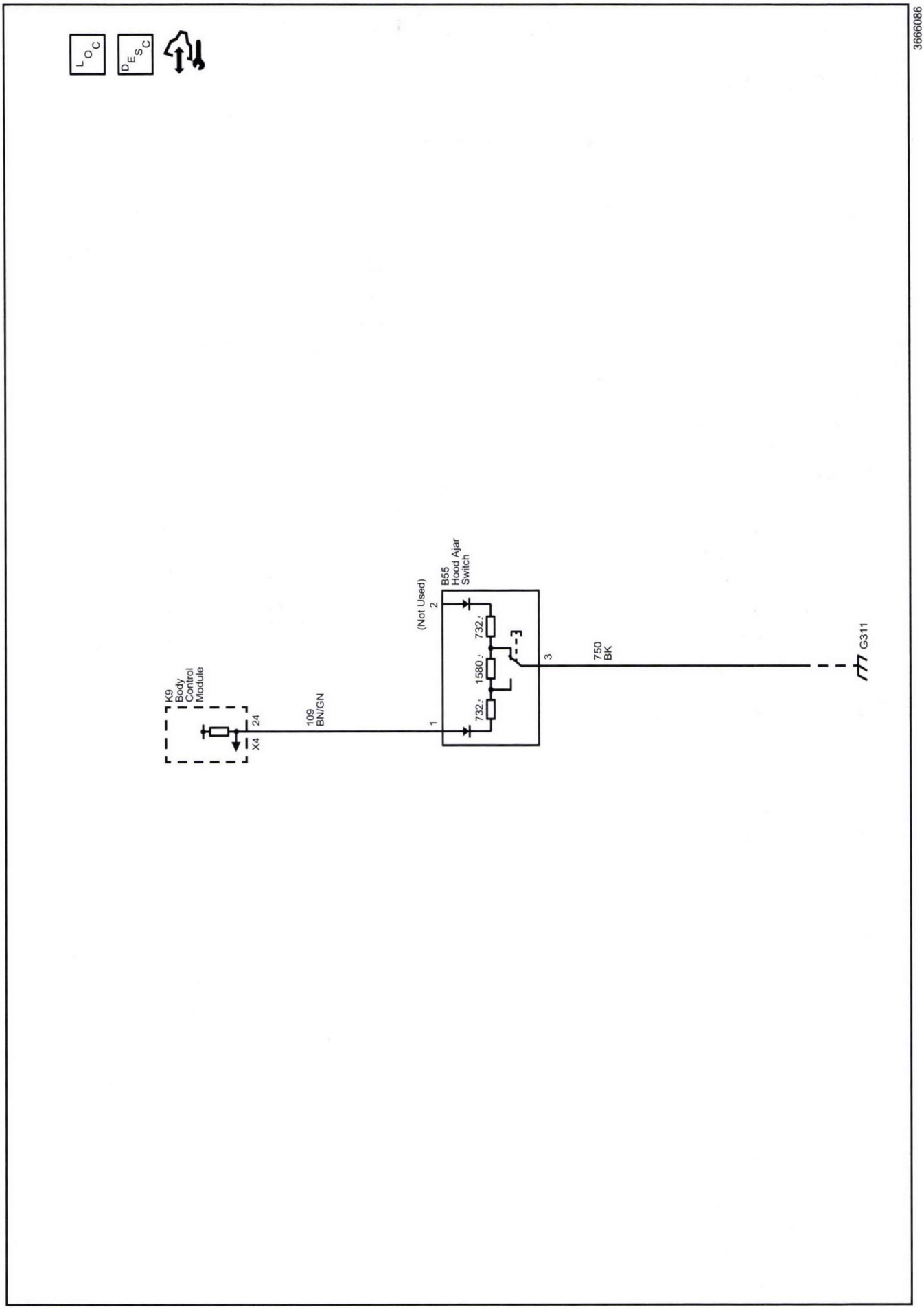
Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Front Fender Bolt	7.5 N•m	66 lb in
Front Side Door Check Bolt	5.5 N•m	49 lb in
Front Side Door Check Link Bolt	22 N•m	16 lb ft
Front Side Door Hinge Bolt	30 N•m	22 lb ft
Front Side Door Lower Hinge Bolt	25 N•m	18 lb ft
Front Side Door Upper Hinge Bolt	25 N•m	18 lb ft
Hood Bolt	18 N•m	13 lb ft
Hood Hinge Bolt	18 N•m	13 lb ft
Hood Primary and Secondary Latch	8.5 N•m	75 lb in
Liftgate Hinge Nut	22 N•m	16 lb ft
Plenum Front Panel Bolt	11.5 N•m	102 lb in
Rear Side Door Check Bolt	5.5 N•m	49 lb in
Rear Side Door Check Link Bolt	22 N•m	16 lb ft
Rear Side Door Hinge Bolt	30 N•m	22 lb ft
Rear Side Door Lower Hinge Bolt	25 N•m	18 lb ft
Rear Side Door Upper Hinge Bolt	25 N•m	18 lb ft

Schematic and Routing Diagrams

Hood Latch Schematics (Hood Latch)



Diagnostic Information and Procedures

DTC B3006

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B3006 01: Hood Ajar Circuit Short to Battery
DTC B3006 02: Hood Ajar Circuit Short to Ground
DTC B3006 04: Hood Ajar Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B3006 02	B3006 04	B3006 01	—
Ground	—	B3006 04	—	—

Circuit/System Description

The body control module (BCM) applies B+ to the hood ajar signal circuit and monitors the voltage to determine the position of the hood. When the hood is closed, the switch is open and voltage remains high. When the hood is open, the switch is closed and the voltage is pulled low.

Conditions for Running the DTC

The BCM continuously monitors for this DTC

Conditions for Setting the DTC

B3006 01

The BCM detects that the hood ajar switch signal circuit is shorted to battery.

B3006 02

The BCM detects that the hood ajar switch signal circuit is shorted to ground.

B3006 04

The BCM detects that the hood ajar switch signal circuit is open.

Action Taken When the DTC Sets

- The hood ajar switch input will be ignored as a content theft deterrent trigger.
- Remote vehicle start will be disabled.

Conditions for Clearing the DTC

- A current DTC will clear when the conditions for setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction free ignition cycles.

Reference Information

Schematic Reference

Immobilizer Schematics on page 12-4

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Keyless Entry System Description and Operation on page 12-79

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Hood Ajar Switch parameter is Open when the hood is open and Closed when the hood is closed.

⇒ **If the parameter does not change**

Refer to Circuit/System Testing.

⇓ **If the parameter changes**

3. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B55 Hood Ajar Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.

⇒ **If 10 Ω or greater**

2.1. Ignition OFF

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Ignition ON.
4. Test for greater than 11.5 V between the signal circuit terminal 1 and ground.

⇒ **If 11.5 V or less**

4.1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If Infinite resistance.

4.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If greater than 11.5 V**

5. Ignition OFF, disconnect the X4 and X7 harness connector at the K9 Body Control Module. Ignition ON.
6. Test for less than 1 V between the signal circuit terminal 1 and ground.

⇒ **If 1 V or greater**

Repair the short to voltage on the circuit.

⇓ **If less than 1 V**

7. Test or replace the B55 Hood Ajar Switch.

Component Testing

1. Ignition OFF, disconnect the harness connector at the B55 Hood Ajar Switch.
2. Test for 2738–3350 Ω between the signal terminal 1 and the signal terminal 2 with the hood latch in the CLOSED position.

⇒ **If not between 2738–3350 Ω**

Replace the B55 Hood Ajar Switch.

⇓ **If between 2738–3350 Ω**

3. Test for 658–806 Ω between the signal terminal 2 and the ground terminal 3 with the hood latch in the CLOSED position.

⇒ **If not between 658–806 Ω**

Replace the B55 Hood Ajar Switch.

⇓ **If between 658–806 Ω**

4. Test for 2080–2545 Ω between the signal terminal 1 and the ground terminal 3 with the hood latch in the CLOSED position.

⇒ **If not between 2080–2545 Ω**

Replace the B55 Hood Ajar Switch.

⇓ **If between 2080–2545 Ω**

5. Test for 2738–3350 Ω between the signal terminal 1 and the signal terminal 2 with the hood latch in the OPEN position.

⇒ **If not between 2738–3350 Ω**

Replace the B55 Hood Ajar Switch.

⇓ **If between 2738–3350 Ω**

6. Test for 2080–2545 Ω between the signal terminal 2 and the ground terminal 3 with the hood latch in the OPEN position.

⇒ **If not between 2080–2545 Ω**

Replace the B55 Hood Ajar Switch.

⇓ **If between 2080–2545 Ω**

7. Test for 658–806 Ω between the signal terminal 1 and the ground terminal 3 with the hood latch in the OPEN position.

⇒ **If not between 658–806 Ω**

Replace the B55 Hood Ajar Switch.

⇓ **If between 658–806 Ω**

8. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Hood Primary and Secondary Latch Replacement on page 3-33*
- *Control Module References on page 6-3* for Body Control Module replacement, programming, and setup

DTC P257D-P257F

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC P257D: Engine Hood Switch Performance
DTC P257E: Engine Hood Switch Circuit Low Voltage
DTC P257F: Engine Hood Switch Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Hood Ajar Switch Signal 1	B3006 02	B3006 04	B3006 01	—
Hood Ajar Switch Signal 2	P257E	P257F	P257F	P257D
Ground	—	B3006 04, P257F	—	—

Circuit/System Description

The Hybrid/EV Powertrain Control Module 2 applies B+ to the hood ajar signal 2 circuit and monitors the voltage to determine the position of the hood. The hood ajar switch contains a multiplexed resistor. This resistor will vary the voltage seen by the Hybrid/EV Powertrain Control Module 2 by pulling down the applied voltage based on the position of the switch.

Conditions for Running the DTC

Propulsion system is active.

Conditions for Setting the DTC

P257D

The hood ajar switch signal voltage as measured by the Hybrid/EV Powertrain Control Module 2 is not within a valid voltage range.

P257E

The Hybrid/EV Powertrain Control Module 2 detects a short to ground in the hood ajar switch signal.

P257F

The Hybrid/EV Powertrain Control Module 2 detects a short to voltage or an open/high resistance in the hood ajar switch signal.

Action Taken When the DTC Sets

The engine will start and run whenever the vehicle is in Service Mode or the vehicle speed is less than 5 kph (3 mph).

Conditions for Clearing the DTC

DTCs P257D, P257E, and P257F are Type B DTCs.

Reference Information

Schematic Reference

Immobilizer Schematics on page 12-4

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Hood Ajar Indicator Description and Operation on page 3-46

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Hybrid/EV Powertrain Control Module 2 Hood Position parameter is Open when the hood is OPEN and Closed when the hood is CLOSED..

⇒ **If the parameter does not change**

Refer to Circuit/System Testing.

⇓ **If the parameter changes**

3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B55 Hood Ajar Switch. It may take up to two minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal C and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify DTC P257F is set as current

⇒ **If DTC P257F is not set as current**

4.1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

4.2. Test for infinite resistance between the signal circuit terminal A and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

⇓ **If DTC P257F is set as current**

5. Install a 5 A fused jumper wire between the signal circuit terminal A and ground. Vehicle in Service Mode.
6. Verify DTC P257E is set as current.

⇒ **If DTC P257E is not set as current**

6.1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

6.2. Test for less than 1 V between the signal circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.

⇓ **If DTC P257E is set as current**

7. Test or replace the B55 Hood Ajar Switch.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the B55 Hood Ajar Switch.
2. Test for 2738–3350 Ω between the signal terminal A and the signal terminal B with the hood latch in the CLOSED position.

⇒ **If not between 2738–3350 Ω**

Replace the B55 Hood Ajar Switch.

⇓ **If between 2738–3350 Ω**

3. Test for 658–806 Ω between the signal terminal A and the ground terminal C with the hood latch in the CLOSED position.

⇒ **If not between 658–806 Ω**

Replace the B55 Hood Ajar Switch.

⇓ **If between 658–806 Ω**

4. Test for 2080–2545 Ω between the signal terminal B and the ground terminal C with the hood latch in the CLOSED position.

⇒ **If not between 2080–2545 Ω**

Replace the B55 Hood Ajar Switch.

⇓ **If between 2080–2545 Ω**

5. Test for 2738–3350 Ω between the signal terminal A and the signal terminal B with the hood latch in the OPEN position.

⇒ **If not between 2738–3350 Ω**

Replace the B55 Hood Ajar Switch.

⇓ **If between 2738–3350 Ω**

6. Test for 2080–2545 Ω between the signal terminal A and the ground terminal C with the hood latch in the OPEN position.

⇒ **If not between 2080–2545 Ω**

Replace the B55 Hood Ajar Switch.

⇓ **If between 2080–2545 Ω**

7. Test for 658–806 Ω between the signal terminal B and the ground terminal C with the hood latch in the OPEN position.

⇒ **If not between 658–806 Ω**

Replace the B55 Hood Ajar Switch.

⇓ **If between 658–806 Ω**

8. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Hood Primary and Secondary Latch Replacement on page 3-33*
- *Control Module References on page 6-3* for Hybrid/EV Powertrain Control Module 2 replacement, programming, and setup

Symptoms - Bolted Exterior Body Panels and Closures

Important: The following steps must be completed before using the symptom tables.

1. Perform the *Diagnostic System Check - Vehicle on page 6-91* before using the symptom tables in order to verify that all of the following are true:
   - There are no DTCs set.
   - The control modules can communicate via the serial data links.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to *Hood Ajar Indicator Description and Operation on page 3-46*.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the systems. Refer to *Checking Aftermarket Accessories on page 11-871*.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to *Testing for Intermittent Conditions and Poor Connections on page 11-877*.

Symptom List

Refer to *Hood Ajar Indicator/Message Malfunction on page 3-9* in order to diagnose the symptom.

Hood Ajar Indicator/Message Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B3006 01: Hood Ajar Circuit Short to Battery
DTC B3006 02: Hood Ajar Circuit Short to Ground
DTC B3006 04: Hood Ajar Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B3006 02	B3006 04	B3006 01	—
Ground	—	B3006 04	—	—

Circuit/System Description

The body control module (BCM) applies B+ to the hood ajar signal circuit and monitors the voltage to determine the position of the hood. When the hood is closed, the switch is open and voltage remains high. When the hood is open, the switch is closed and the voltage is pulled low.

Conditions for Running the DTC

The BCM continuously monitors for this DTC

Conditions for Setting the DTC

B3006 01

The BCM detects that the hood ajar switch signal circuit is shorted to battery.

B3006 02

The BCM detects that the hood ajar switch signal circuit is shorted to ground.

B3006 04

The BCM detects that the hood ajar switch signal circuit is open.

Action Taken When the DTC Sets

- The hood ajar switch input will be ignored as a content theft deterrent trigger.
- Remote vehicle start will be disabled.

Conditions for Clearing the DTC

- A current DTC will clear when the conditions for setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction free ignition cycles.

Reference Information

Schematic Reference

Immobilizer Schematics on page 12-4

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Keyless Entry System Description and Operation on page 12-79

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Hood Ajar Switch parameter is Open when the hood is open and Closed when the hood is closed.

⇒ **If the parameter does not change**

Refer to Circuit/System Testing.

⇓ **If the parameter changes**

3. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B55 Hood Ajar Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.

⇒ **If 10 Ω or greater**

2.1. Ignition OFF

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Ignition ON.
4. Test for greater than 11.5 V between the signal circuit terminal 1 and ground.

⇒ **If 11.5 V or less**

4.1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If Infinite resistance.

4.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If greater than 11.5 V**

5. Ignition OFF, disconnect the X4 and X7 harness connector at the K9 Body Control Module. Ignition ON.
6. Test for less than 1 V between the signal circuit terminal 1 and ground.

⇒ **If 1 V or greater**

Repair the short to voltage on the circuit.

⇓ **If less than 1 V**

7. Test or replace the B55 Hood Ajar Switch.

Component Testing

1. Ignition OFF, disconnect the harness connector at the B55 Hood Ajar Switch.
2. Test for 2738–3350 Ω between the signal terminal 1 and the signal terminal 2 with the hood latch in the CLOSED position.

⇒ **If not between 2738–3350 Ω**

Replace the B55 Hood Ajar Switch.

⇓ **If between 2738–3350 Ω**

3. Test for 658–806 Ω between the signal terminal 2 and the ground terminal 3 with the hood latch in the CLOSED position.

⇒ **If not between 658–806 Ω**

Replace the B55 Hood Ajar Switch.

⇓ **If between 658–806 Ω**

4. Test for 2080–2545 Ω between the signal terminal 1 and the ground terminal 3 with the hood latch in the CLOSED position.

⇒ **If not between 2080–2545 Ω**

Replace the B55 Hood Ajar Switch.

⇓ **If between 2080–2545 Ω**

5. Test for 2738–3350 Ω between the signal terminal 1 and the signal terminal 2 with the hood latch in the OPEN position.

⇒ **If not between 2738–3350 Ω**

Replace the B55 Hood Ajar Switch.

⇓ **If between 2738–3350 Ω**

6. Test for 2080–2545 Ω between the signal terminal 2 and the ground terminal 3 with the hood latch in the OPEN position.

⇒ **If not between 2080–2545 Ω**

Replace the B55 Hood Ajar Switch.

⇓ **If between 2080–2545 Ω**

7. Test for 658–806 Ω between the signal terminal 1 and the ground terminal 3 with the hood latch in the OPEN position.

⇒ **If not between 658–806 Ω**

Replace the B55 Hood Ajar Switch.

⇓ **If between 658–806 Ω**

8. All OK.

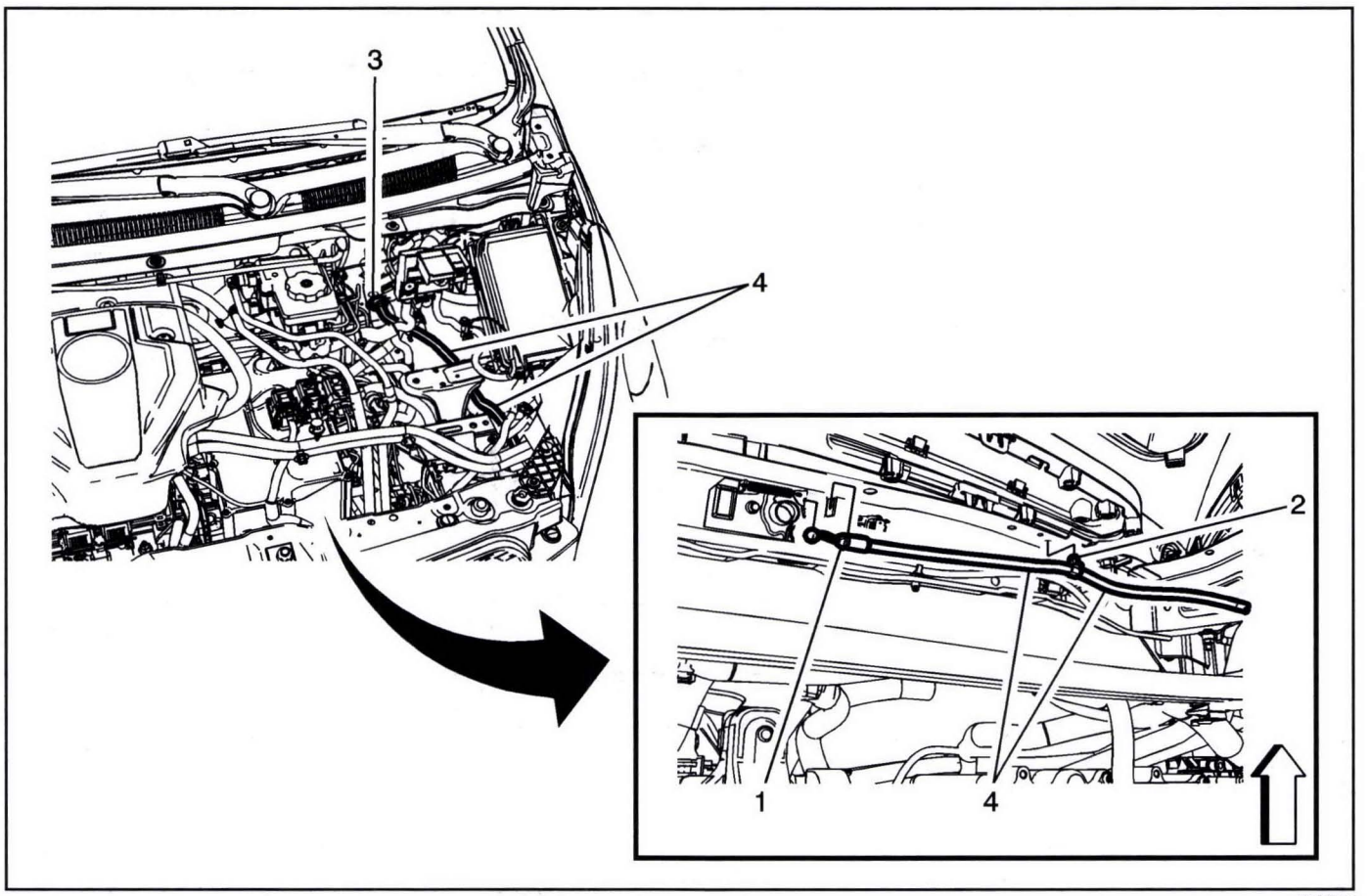
Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Hood Primary and Secondary Latch Replacement on page 3-33*
- *Control Module References on page 6-3* for Body Control Module replacement, programming, and setup

Repair Instructions

Hood Primary Latch Release Cable Replacement

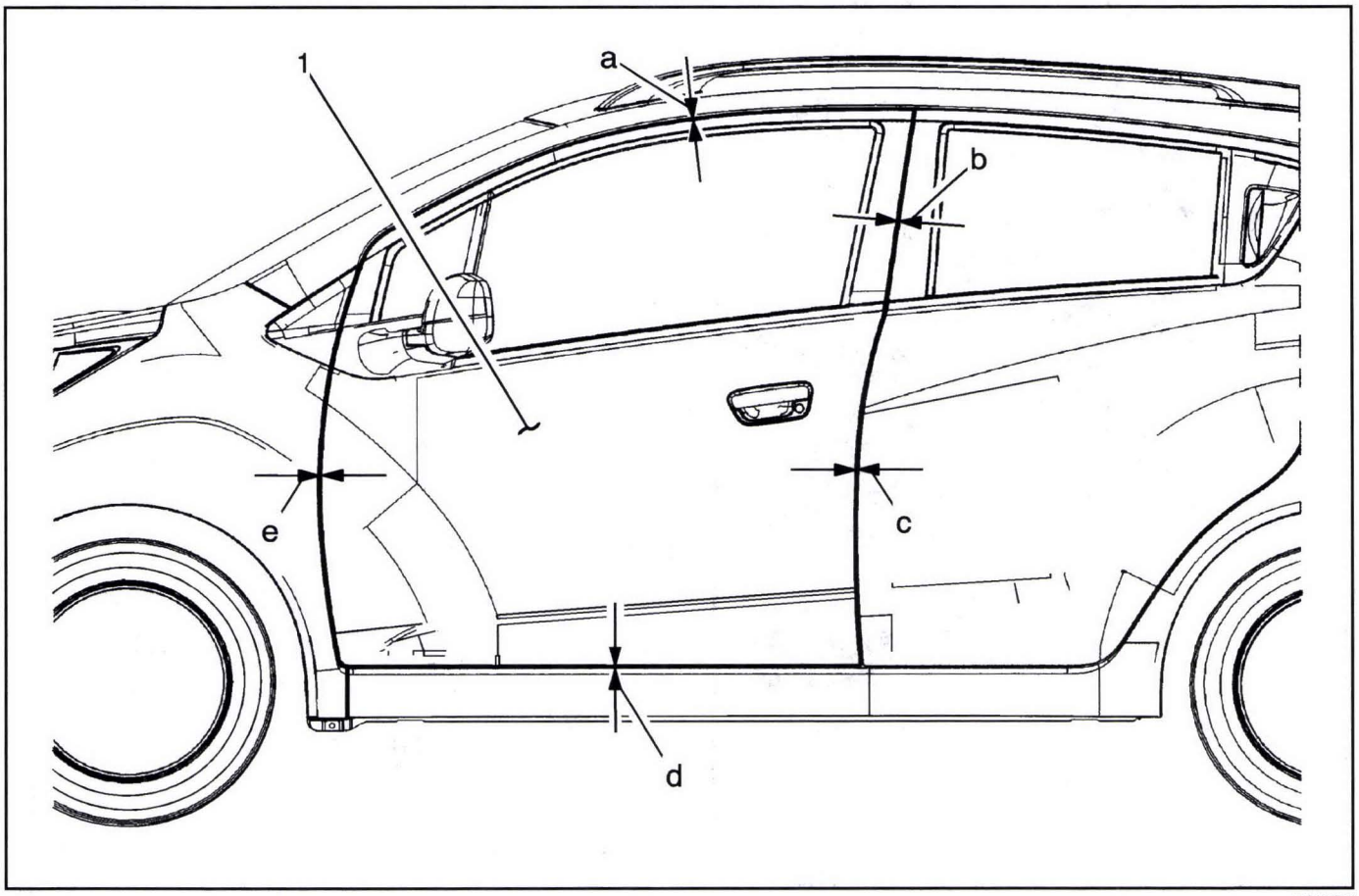


2916705

Hood Primary Latch Release Cable Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the Front Compartment Front Sight Shield. Refer to*Front Compartment Front Sight Shield Replacement on page 3-39*. 2. Remove the hood primary latch release cable handle. Refer to *Hood Primary Latch Release Cable Handle Replacement on page 3-24*.	
1	Hood Primary Latch Cable **Procedure** Disconnect the hood primary latch release cable from the primary hood latch.
2	Hood Primary Latch Release Cable Retainer **Procedure** Disconnect the hood release cable retainers from the hood release cable.
3	Hood Primary Latch Release Cable Grommet
4	Hood Primary Latch Release Cable **Procedure** Disconnect the hood primary latch release cable from the hood latch cable handle.

Front Side Door Adjustment



3419487

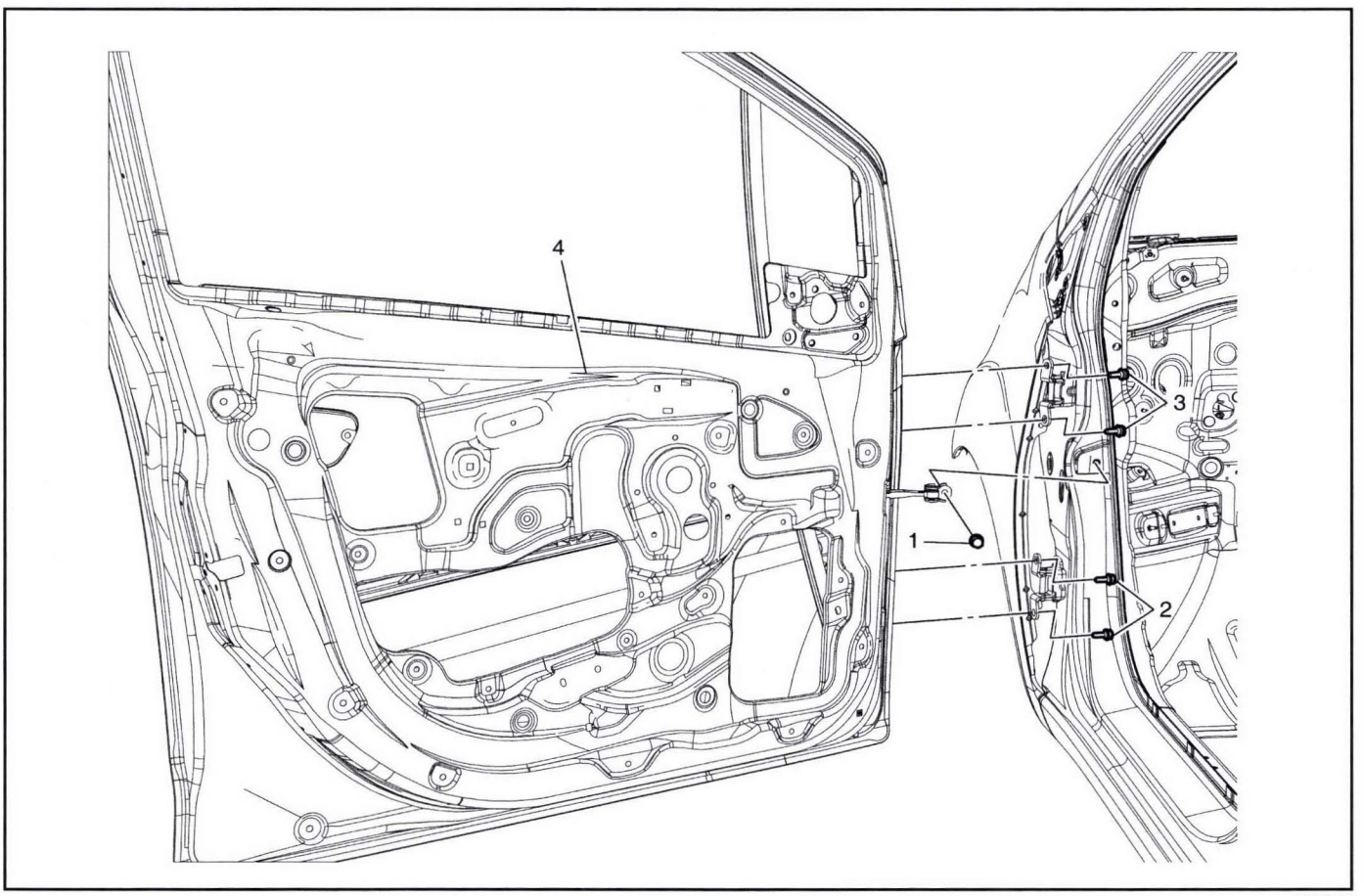
Front Side Door Adjustment

Callout	Component Name
Preliminary Procedure Remove the front wheelhouse liner. Refer to *Front Wheelhouse Liner Replacement - Right Side on page 3-138* or *Front Wheelhouse Liner Replacement - Left Side on page 3-139*.	

Front Side Door Adjustment (cont'd)

Callout	Component Name
1	Front Side Door **Caution:** Refer to *Fastener Caution on page 0-8*. **Procedure** 1. Loosen the front side door hinge bolt (Qty: 4) to adjust the front side door. 2. Adjust the front side door in order to obtain an even gap between the front side door and the roof, the rear door, the rocker panel and the front fender and so that the front side door is flush with the roof, the rear door, the rocker panel and the front fender. **Adjustment** • Front side door to roof (a) 4.0 mm ± 1.0 mm (0.16 in ± 0.04 in) • Front side door to rear door (above belt) (b) 3.5 mm ± 1.0 mm (0.14 in ± 0.04 in) • Front side door to rear door (below belt) (c) 3.5 mm ± 0.75 mm (0.14 in ± 0.03 in) • Front side door to rocker panel (d) 5.5 mm ± 1.0 mm (0.22 in ± 0.04 in) • Front side door to fender (e) 3.5 mm ± 0.75 mm (0.14 in ± 0.03 in) **Tighten** 25 N•m (19 lb ft)

Front Side Door Replacement

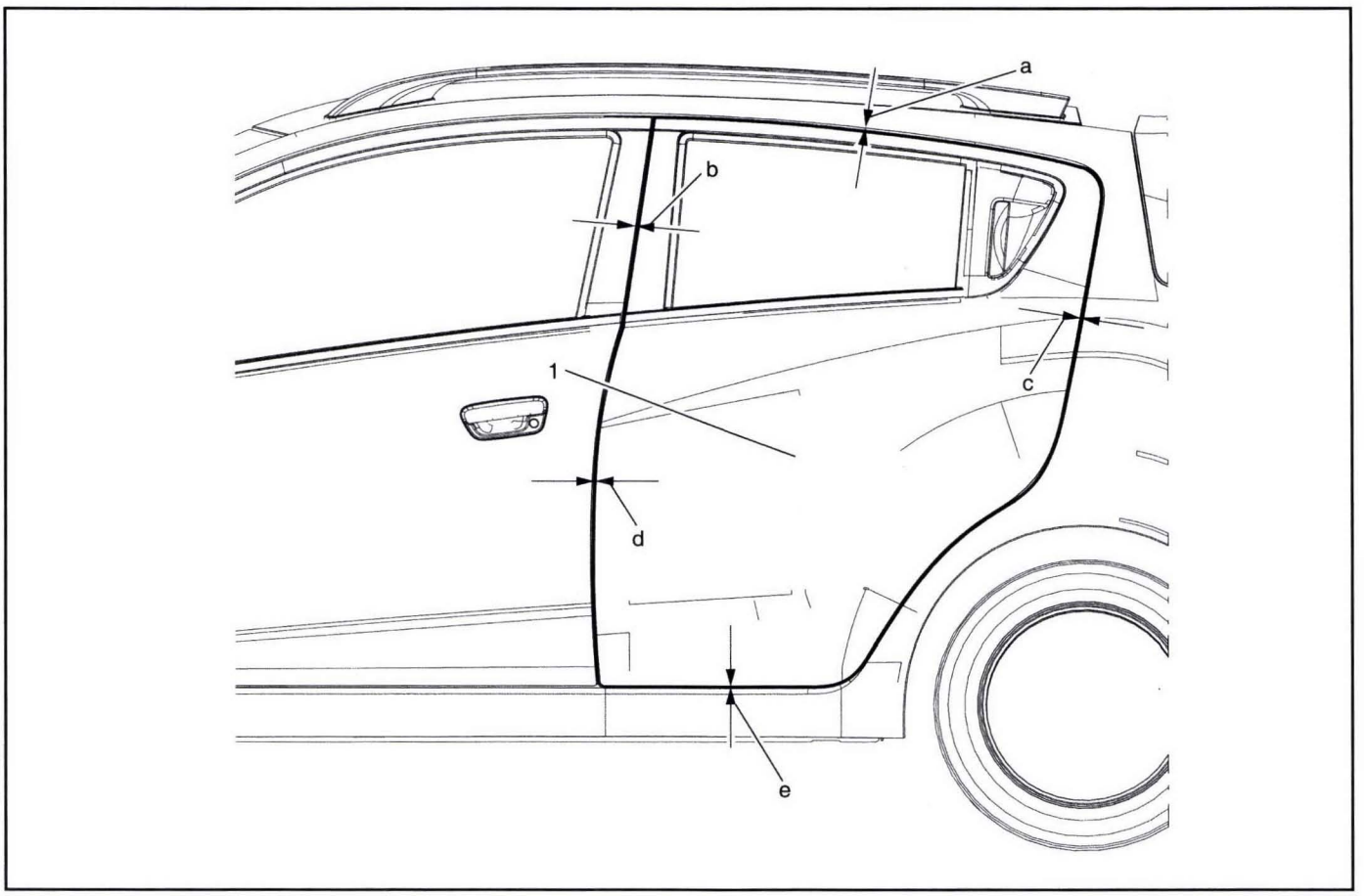


2309107

Front Side Door Replacement

Callout	Component Name
Warning: Refer to SIR Warning on page 0-7.	
Preliminary Procedures 1. Mark the location of the hinge before removing the bolts with a grease pencil. 2. Remove the front door trim panel. Refer to *Front Side Door Trim Replacement on page 2-53*.	
1	Front Side Door Check Link Bolt to Body **Caution:** Refer to *Fastener Caution on page 0-8*. **Procedure** 1. Remove the water deflector. 2. Disconnect the door electrical connector. 3. Support the door before removing the hinge bolts. 4. With an assistant, remove the door. 5. After the door has been removed, ensure that the dome lamp is off. If the dome lamp is on remove the fuse. **Tighten** 22 N•m (16 lb ft)
2	Front Side Door Lower Hinge Bolt to Door (Qty: 2) **Tighten** 25 N•m (18 lb ft)
3	Front Side Door Upper Hinge Bolt to Door (Qty: 2) **Tighten** 25 N•m (18 lb ft)
4	Front Side Door Assembly **Procedure** 1. When replacing the door it is necessary to transfer all of the internal components. 2. If the door striker needs adjust. Refer to *Front Side Door Lock Striker Adjustment on page 4-278*. 3. Front door adjustment. Refer to *Front Side Door Adjustment on page 3-12*.

Rear Side Door Adjustment

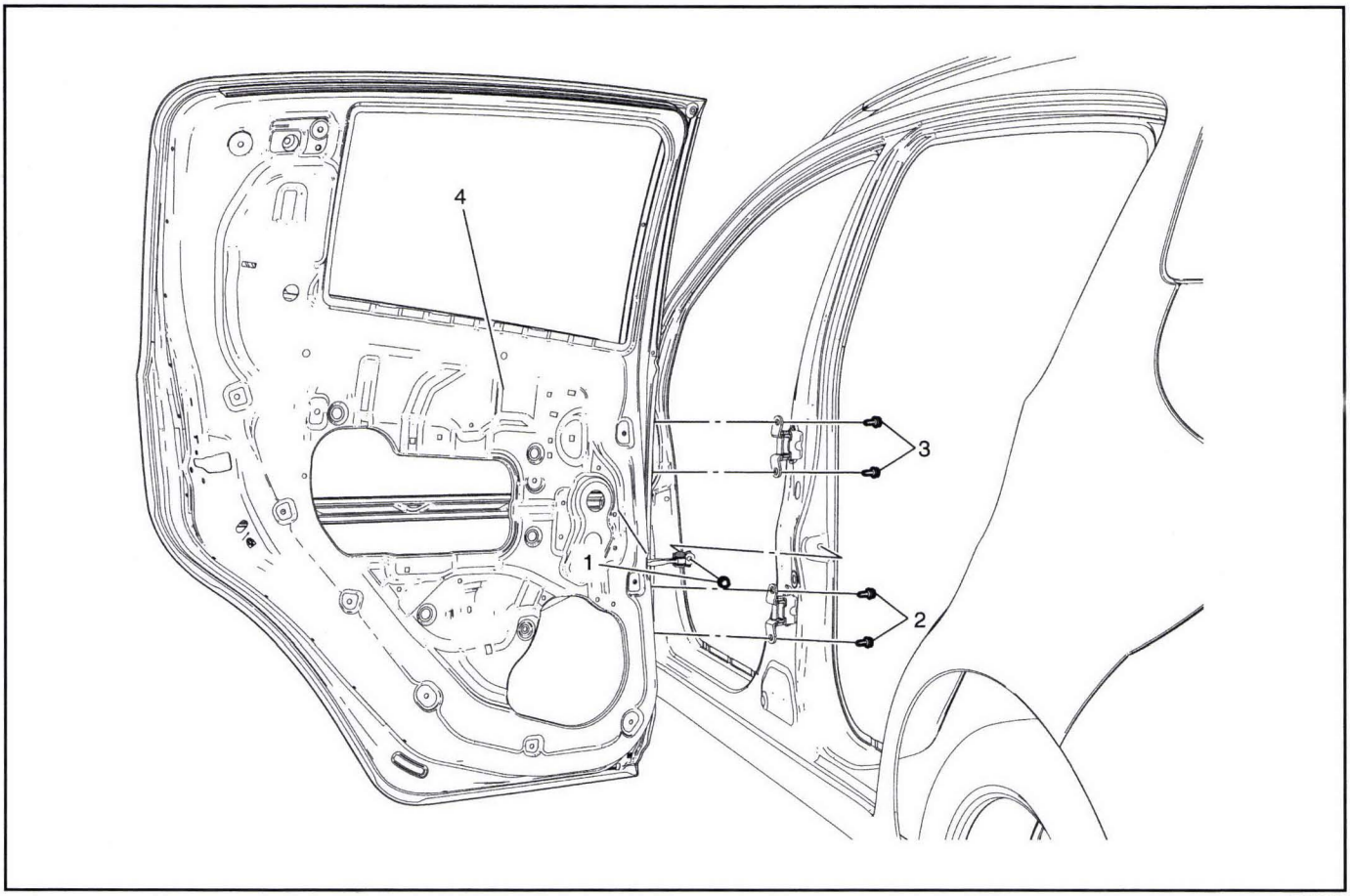


2309108

Rear Side Door Adjustment

Callout	Component Name
1	Rear Side Door **Caution:** Refer to *Fastener Caution on page 0-8*. **Procedure** 1. Loosen the rear door hinge bolt (Qty: 4) to adjust the rear door. 2. Adjust the rear door in order to obtain an even gap between the rear door and the roof, the quarter outer panel, the rocker panel and the front side door and so that the rear door is flush with the roof, the quarter outer panel, the rocker panel and the front side door. **Adjustment** • Rear side door to roof (a) 4.0 mm ± 1.0 mm (0.16 in ± 0.04 in) • Rear side door to front door (above belt) (b) 3.5 mm ± 1.0 mm (0.14 in ± 0.04 in) • Rear side door to rocker panel (c) 3.5 mm ± 0.75 mm (0.14 in ± 0.03 in) • Rear side door to front side door (below belt) (d) 3.5 mm ± 0.75 mm (0.14 in ± 0.03 in) • Rear side door to rocker panel (e) 5.5 mm ± 1.0 mm (0.22 in ± 0.04 in) **Tighten** 25 N•m (18 lb ft)

Rear Side Door Replacement



2309110

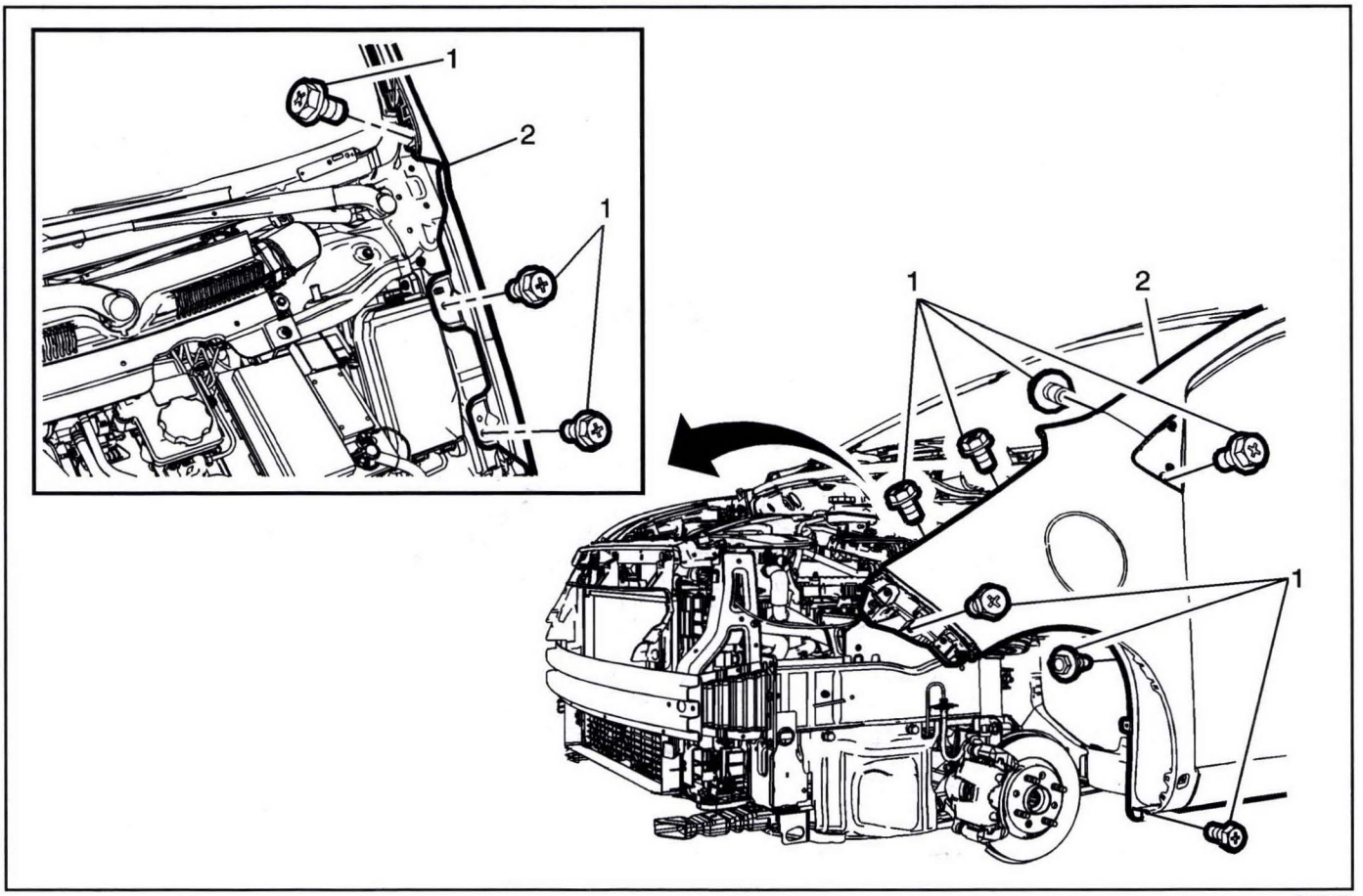
Rear Side Door Replacement

Callout	Component Name
Warning: Refer to SIR Warning on page 0-7.	
Preliminary Procedures 1. Mark the location of the hinge before removing the bolts with a grease pencil. 2. Remove the rear door trim panel. Refer to *Rear Side Door Trim Replacement on page 2-68*.	
1	Rear Side Door Check Link Bolt to Body **Caution:** Refer to *Fastener Caution on page 0-8*. **Procedure** 1. Remove the water deflector. 2. Disconnect the door electrical connector. 3. Support the door before removing the hinge bolts. 4. With an assistant, remove the door. 5. After the door has been removed, ensure that the dome lamp is off. If the dome lamp is on remove the fuse. **Tighten** 22 N•m (16 lb ft)
2	Rear Side Door Lower Hinge Bolt to Door (Qty: 2) **Tighten** 25 N•m (18 lb ft)
3	Rear Side Door Upper Hinge Bolt to Door (Qty: 2) **Tighten** 25 N•m (18 lb ft)

Rear Side Door Replacement (cont'd)

Callout	Component Name
4	Rear Side Door Assembly **Procedure** 1. When replacing the door it is necessary to transfer all of the internal components. 2. If the door striker needs adjust. Refer to *Rear Side Door Lock Striker Adjustment on page 4-280*. 3. Rear door adjustment. Refer to *Rear Side Door Adjustment on page 3-15*.

Front Fender Replacement - Left Side



2916681

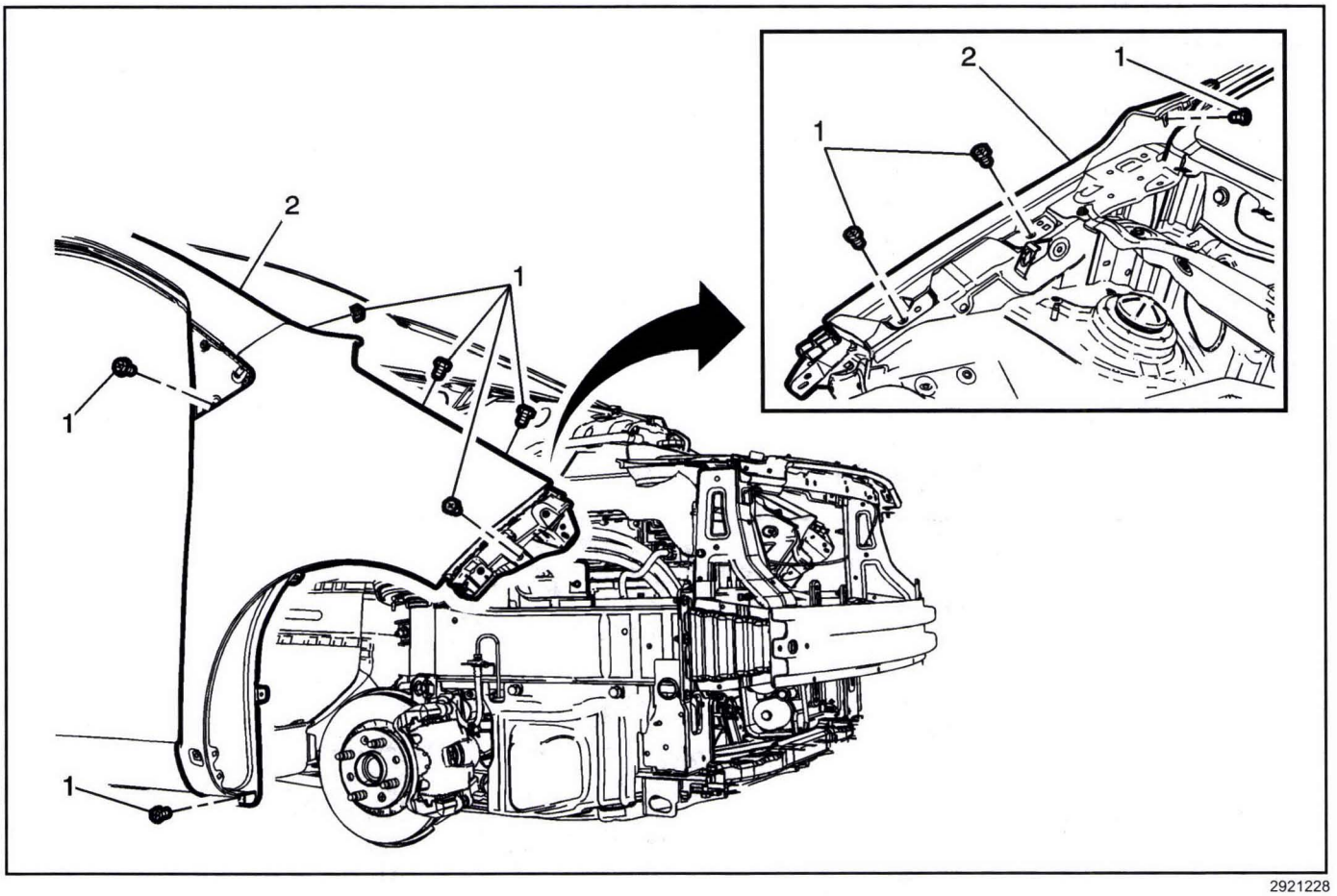
Front Fender Replacement - Left Side

Callout	Component Name
	Preliminary Procedures 1. Remove the front bumper fascia. Refer to *Front Bumper Fascia Replacement on page 3-57*. 2. Remove the headlamp. Refer to *Headlamp Replacement on page 4-178*. 3. Remove the front bumper fascia side bracket. refer to *Front Bumper Fascia Side Bracket Replacement on page 3-58*. 4. Remove the front wheelhouse liner front and rear. Refer to *Front Wheelhouse Liner Replacement - Left Side on page 3-139*. 5. Remove the air inlet grille panel. Refer to *Air Inlet Grille Panel Replacement on page 4-327*. 6. Remove the rocker panel molding. Refer to *Rocker Panel Molding Replacement on page 2-15*. 7. Remove the body side upper front applique. Refer to *Body Side Upper Front Applique Replacement on page 2-5*.
1	Front Fender Bolt (Qty: 7) **Tighten** 7.5 N•m (66 lb in)

Front Fender Replacement - Left Side (cont'd)

Callout	Component Name
2	Front Fender **Procedure** 1. Disconnect the electrical connectors. 2. Transfer parts as needed.

Front Fender Replacement - Right Side

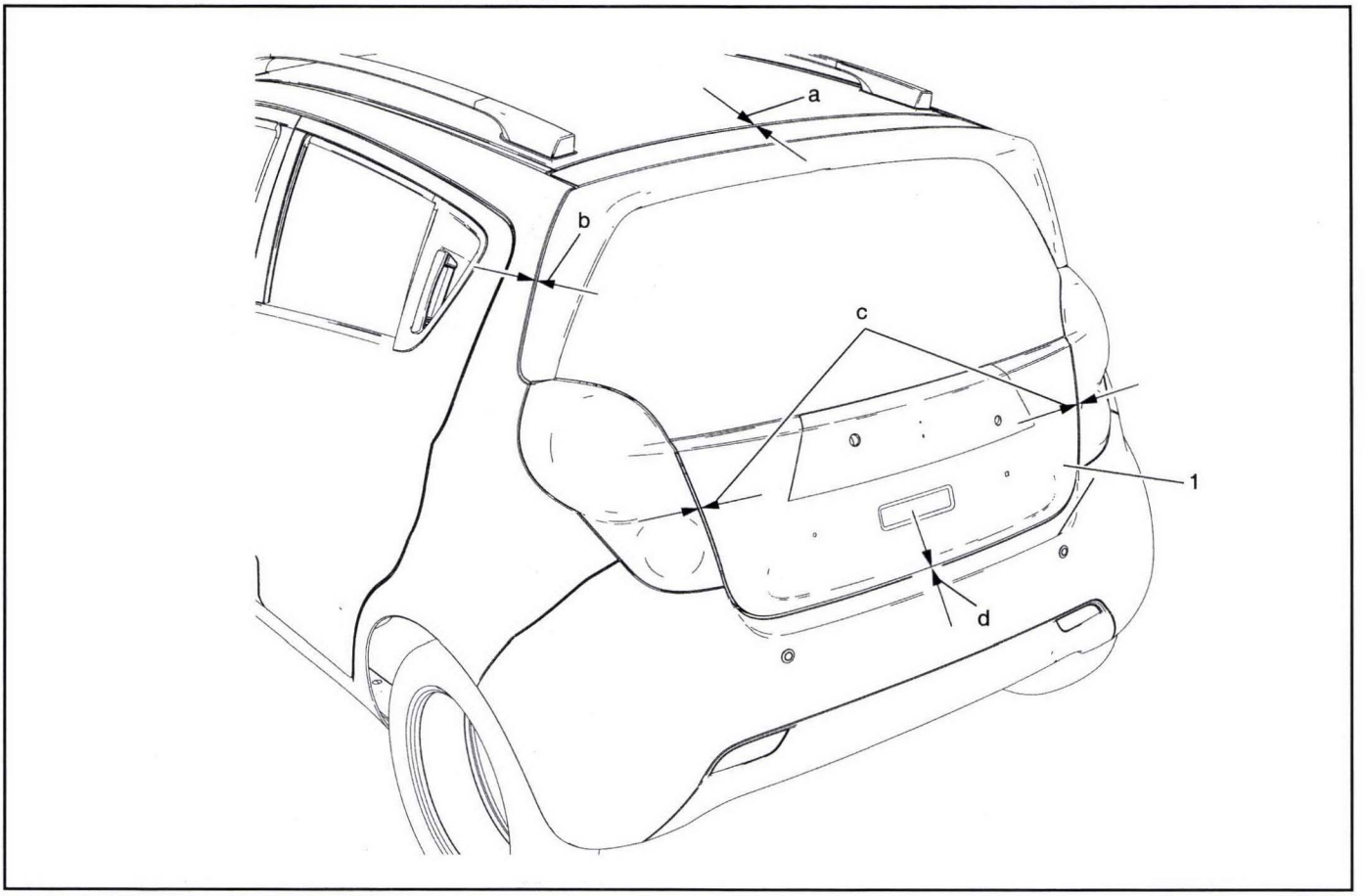


2921228

Front Fender Replacement - Right Side

Callout	Component Name
Preliminary Procedure 1. Remove the front bumper fascia. Refer to *Front Bumper Fascia Replacement on page 3-57*. 2. Remove the headlamp. Refer to *Headlamp Replacement on page 4-178*. 3. Remove the front bumper fascia side bracket. Refer to *Front Bumper Fascia Side Bracket Replacement on page 3-58* 4. Remove the wheelhouse liner. Refer to *Front Wheelhouse Liner Replacement - Right Side on page 3-138*. 5. Remove the air inlet grille panel. Refer to *Air Inlet Grille Panel Replacement on page 4-327*. 6. Remove the rocker panel molding. Refer to *Rocker Panel Molding Replacement on page 2-15* 7. Remove the body side upper front applique. Refer to *Body Side Upper Front Applique Replacement on page 2-5*	
1	Front Fender Bolt (Qty: 6) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 7.5 N•m (66 lb in)
2	Front Fender

Liftgate Adjustment

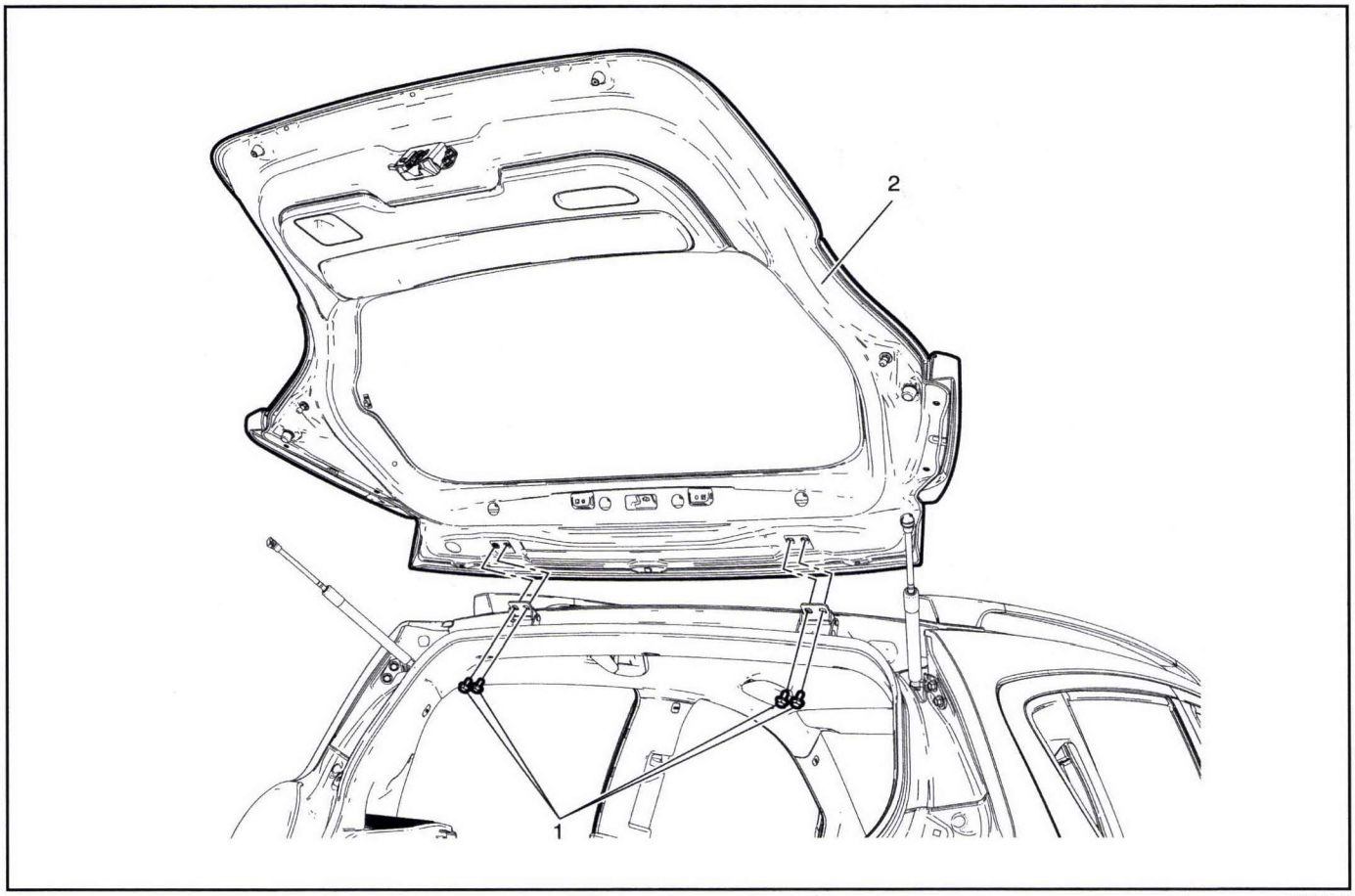


2309112

Liftgate Adjustment

Callout	Component Name
1	Liftgate **Caution:** Refer to *Fastener Caution on page 0-8*. **Procedure** 1. Loosen the 4 liftgate hinge bolts to adjust the liftgate. 2. Adjust the liftgate in order to obtain an even gap between the liftgate and the roof, the quarter outer panel, the tail lamp and rear bumper fascia and so that the liftgate is flush with the roof, the quarter outer panel, the tail lamp and rear bumper fascia. **Adjustment:** • Liftgate to roof (a) 6.0 mm ± 1.0 mm (0.24 in ± 0.04 in) • Liftgate to quarter outer panel (b) 4.0 mm ± 1.0 mm (0.16 in ± 0.04 in) • Liftgate to tail lamp (c) 3.5 mm ± 1.5 mm (0.14 in ± 0.06 in) • Liftgate to rear bumper fascia (d) 5.0 mm ± 1.0 mm (0.20 in ± 0.04 in) **Tighten** 28 N•m (15 lb ft)

Liftgate Replacement

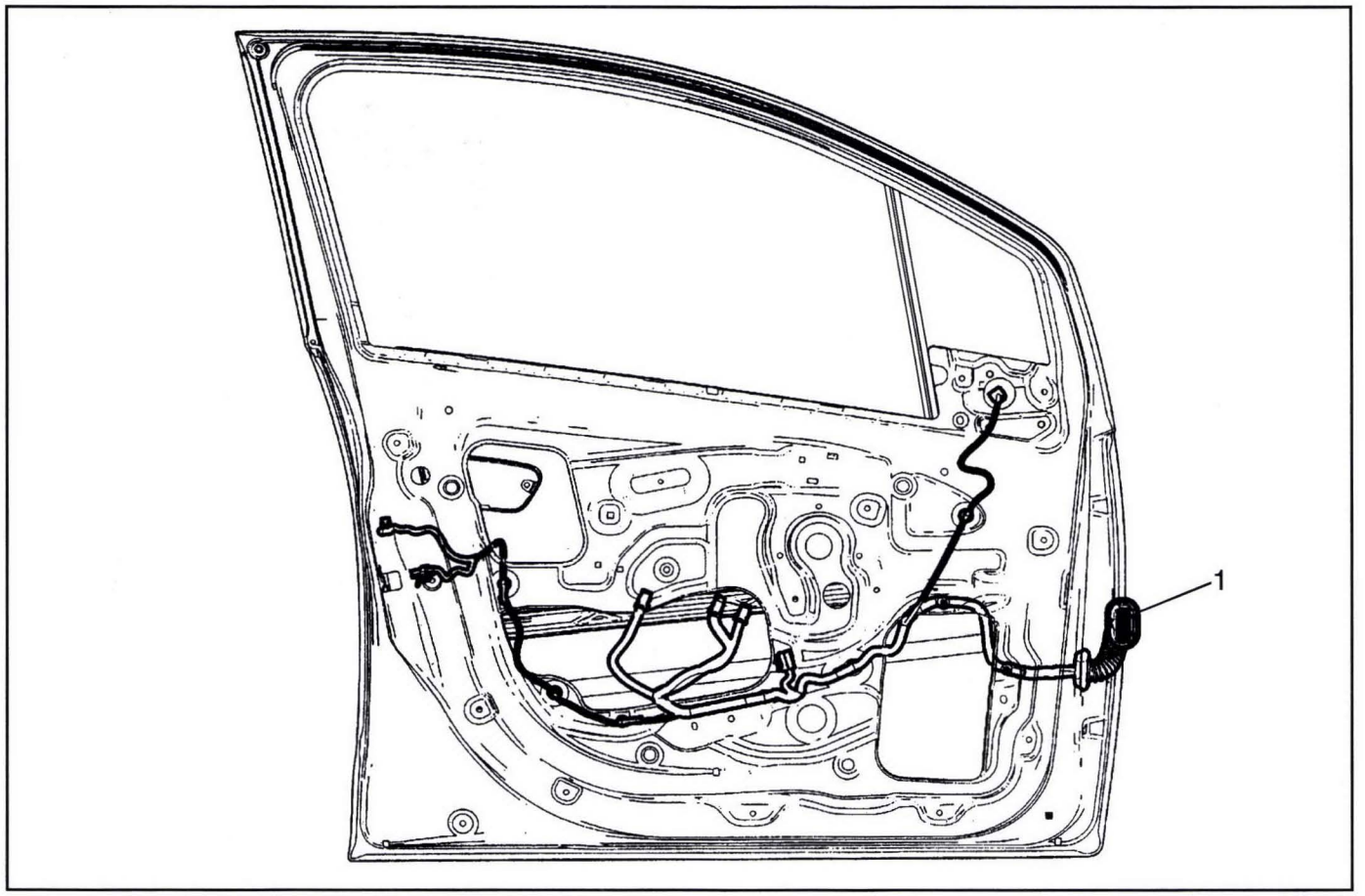


2309115

Liftgate Replacement

Callout	Component Name
Warning: When a lift gate hold open device is being removed or installed, provide alternate support to avoid the possibility of damage to the vehicle or personal injury.	
Preliminary Procedure Release the liftgate strut from the liftgate. Refer to *Liftgate Strut Replacement on page 3-40*.	
1	Liftgate Hinge Bolt (Qty: 4) **Caution:** Refer to *Fastener Caution on page 0-8*. **Procedure** 1. Disconnect the electrical connector. 2. Pull the liftgate wiring grommet, the connectors, and the rear washer hose out of the body. 3. Mark the location of the liftgate hinges to the body with a grease pencil. **Tighten** 20 N•m (15 lb ft)
2	Liftgate **Procedure** 1. Transfer components as necessary. 2. Adjust liftgate as needed. Refer to *Liftgate Adjustment on page 3-19*.

Front Side Door Wiring Harness Replacement

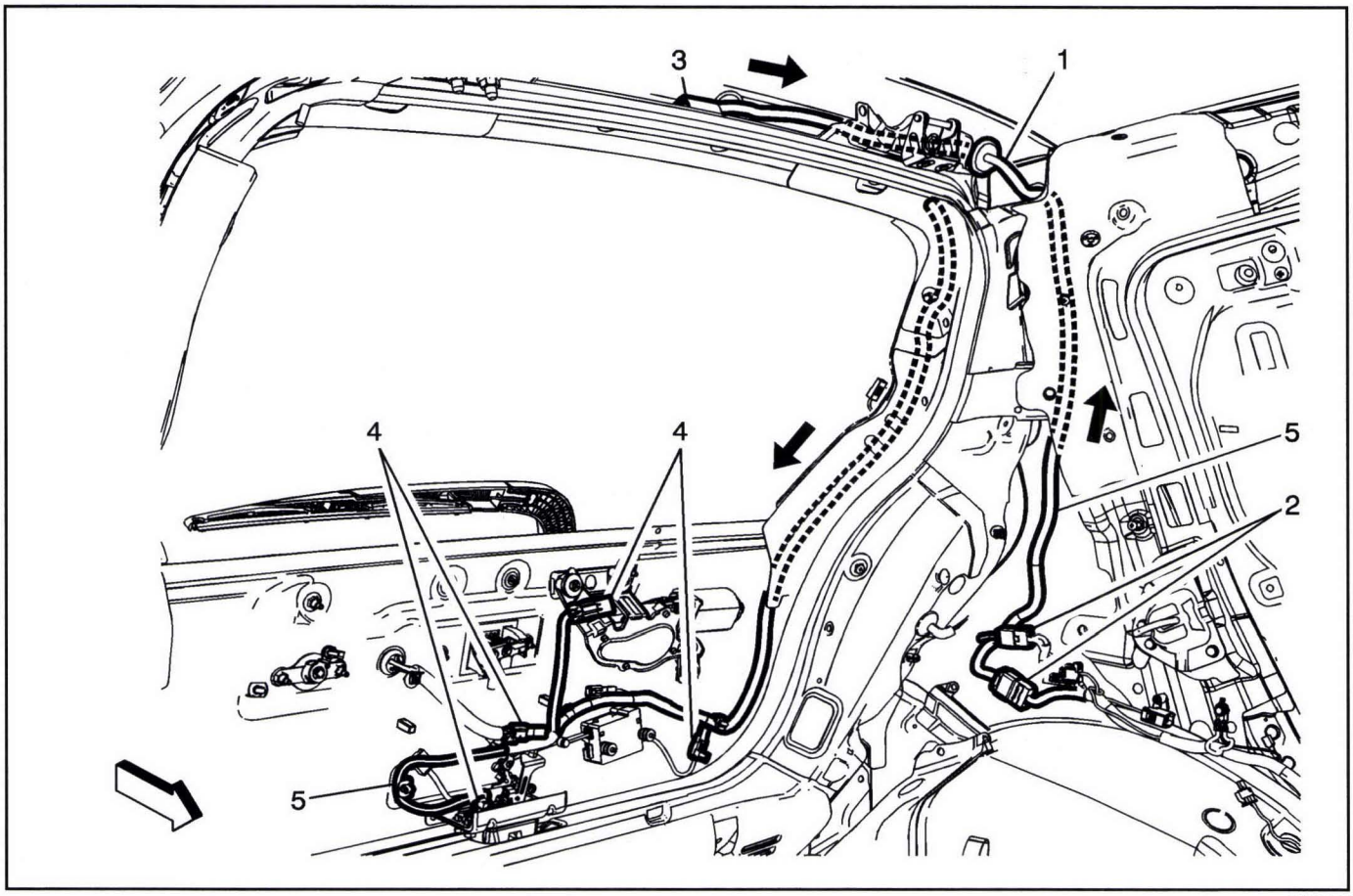


2968860

Front Side Door Wiring Harness Replacement

Callout	Component Name
Preliminary Procedure Remove the front side door trim. Refer to *Front Side Door Trim Replacement on page 2-53*.	
1	Front Side Door Wiring Harness ***Warning: Unless directed otherwise, the ignition must be OFF with the key removed, and all electrical loads must be OFF before servicing any electrical component. Disconnect the negative battery cable to prevent an electrical spark should a tool or equipment come in contact with an exposed electrical terminal. Failure to follow these precautions may result in personal injury and/or damage to the vehicle or its components.*** ***For Vehicles equipped with OnStar® (UE1) with Back Up Battery:*** ***The Back Up Battery is a redundant power supply to allow limited OnStar® functionality in the event of a main vehicle battery power disruption to the VCIM (OnStar®module). Do not disconnect the main vehicle battery or remove the OnStar® fuse with the ignition key in any position other than OFF. Retained accessory power should be allowed to time out or be disabled (simply opening the driver door should disable retained accessory power) before disconnecting power. Disconnecting power to the OnStar® module in any way while the ignition is On or with retained accessory power activated may cause activation of the OnStar® Back-Up Battery system and will discharge and permanently damage the back-up battery. Once the Back-Up Battery is activated it will stay on until it has completely discharged. The back-up battery is not rechargeable and once activated the back-up battery must be replaced.*** **Procedure** 1. Disconnect the battery. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*. 2. Remove the water deflector. 3. Disconnect electrical connectors as needed.

Liftgate Wiring Harness Replacement



2921417

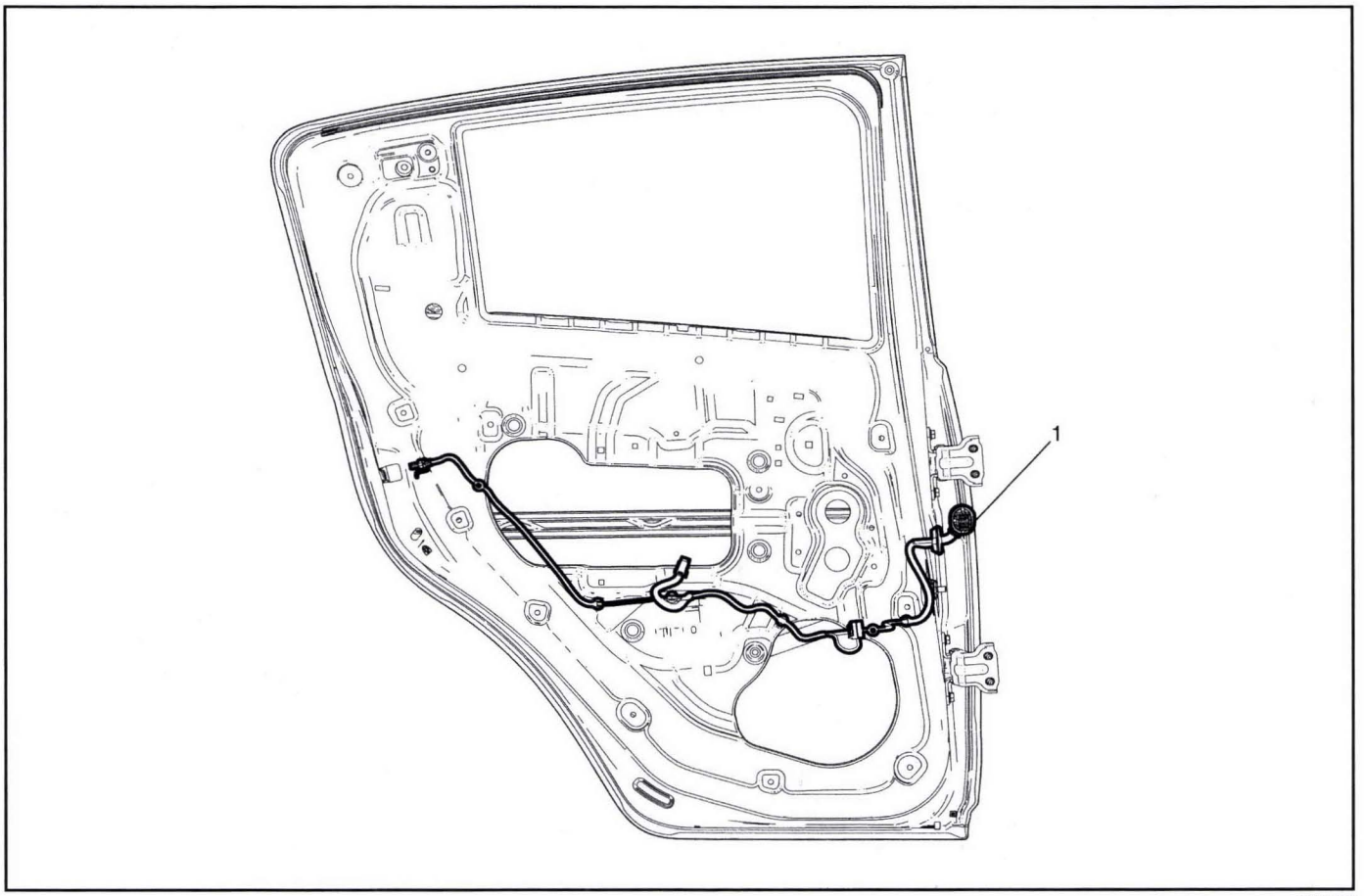
Liftgate Wiring Harness Replacement

Callout	Component Name
Preliminary Procedures 1. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*. 2. Remove the liftgate trim panel. Refer to *Liftgate Trim Finish Panel Replacement on page 2-70*. 3. Remove the quarter lower rear trim panel. Refer to *Quarter Lower Rear Trim Panel Replacement on page 2-65*. 4. Remove the quarter window trim finish panel. Refer to *Quarter Window Trim Finish Panel Replacement on page 2-64*.	
1	Liftgate Wiring Harness Grommet **Procedure** Disconnect the grommet from the liftgate and body.
2	Liftgate Wiring Harness Body Connector **Procedure** 1. Disconnect the liftgate electrical harness body connectors from the body harness. 2. Pull the harness in the direction of the arrow, up through the rear quarter panel.
3	Liftgate Wiring Harness High Mount Stop Lamp Connector **Procedure** 1. Disconnect the high mount stop lamp connector. 2. Pull the harness in the direction of the arrow, through the top of the liftgate.

Liftgate Wiring Harness Replacement (cont'd)

Callout	Component Name
4	Liftgate Wiring Harness Connectors **Procedure** 1. Disconnect the following electrical connectors. • Disconnect the wiper motor connector. • Disconnect the liftgate actuator connector. • Disconnect the heater wiring harness connector. • Disconnect the rear license plate lamp connector. • Disconnect the rear latch release connector. 2. Pull the complete liftgate wiring harness in the direction of the arrow, down through the side of the liftgate and out through the liftgate opening.
5	Liftgate Wiring Harness

Rear Side Door Wiring Harness Replacement



2309120

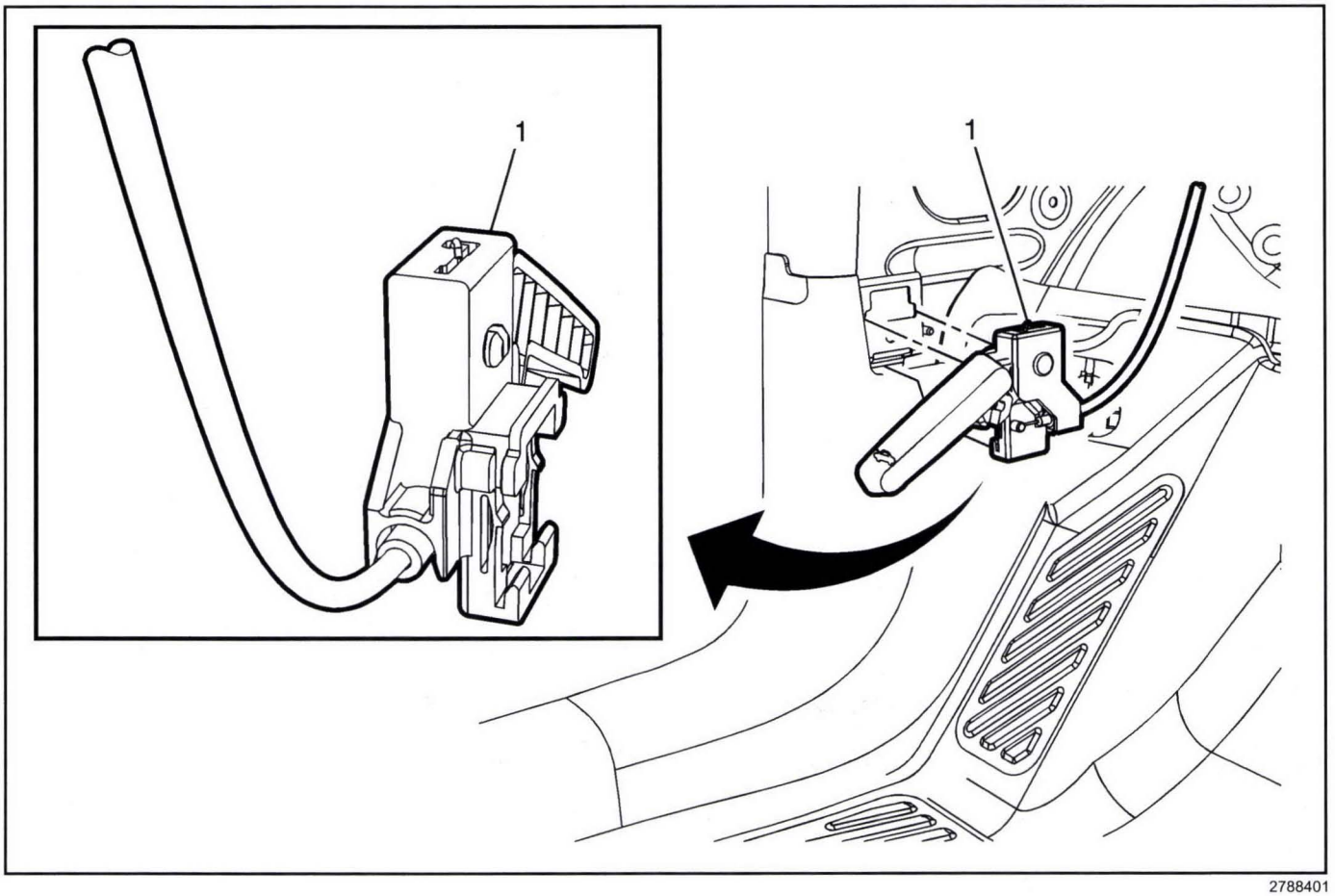
Rear Side Door Wiring Harness Replacement

Callout	Component Name
Preliminary Procedure Remove the rear side door trim. Refer to *Rear Side Door Trim Replacement on page 2-68*.	

Rear Side Door Wiring Harness Replacement (cont'd)

Callout	Component Name
1	Rear Side Door Wiring Harness ***Warning: Unless directed otherwise, the ignition must be OFF with the key removed, and all electrical loads must be OFF before servicing any electrical component. Disconnect the negative battery cable to prevent an electrical spark should a tool or equipment come in contact with an exposed electrical terminal. Failure to follow these precautions may result in personal injury and/or damage to the vehicle or its components.*** ***For Vehicles equipped with OnStar® (UE1) with Back Up Battery:*** ***The Back Up Battery is a redundant power supply to allow limited OnStar® functionality in the event of a main vehicle battery power disruption to the VCIM (OnStar®module). Do not disconnect the main vehicle battery or remove the OnStar® fuse with the ignition key in any position other than OFF. Retained accessory power should be allowed to time out or be disabled (simply opening the driver door should disable retained accessory power) before disconnecting power. Disconnecting power to the OnStar® module in any way while the ignition is On or with retained accessory power activated may cause activation of the OnStar® Back-Up Battery system and will discharge and permanently damage the back-up battery. Once the Back-Up Battery is activated it will stay on until it has completely discharged. The back-up battery is not rechargeable and once activated the back-up battery must be replaced.*** **Procedure** 1. Disconnect the battery. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*. 2. Remove the water deflector. 3. Disconnect electrical connectors as needed.

Hood Primary Latch Release Cable Handle Replacement

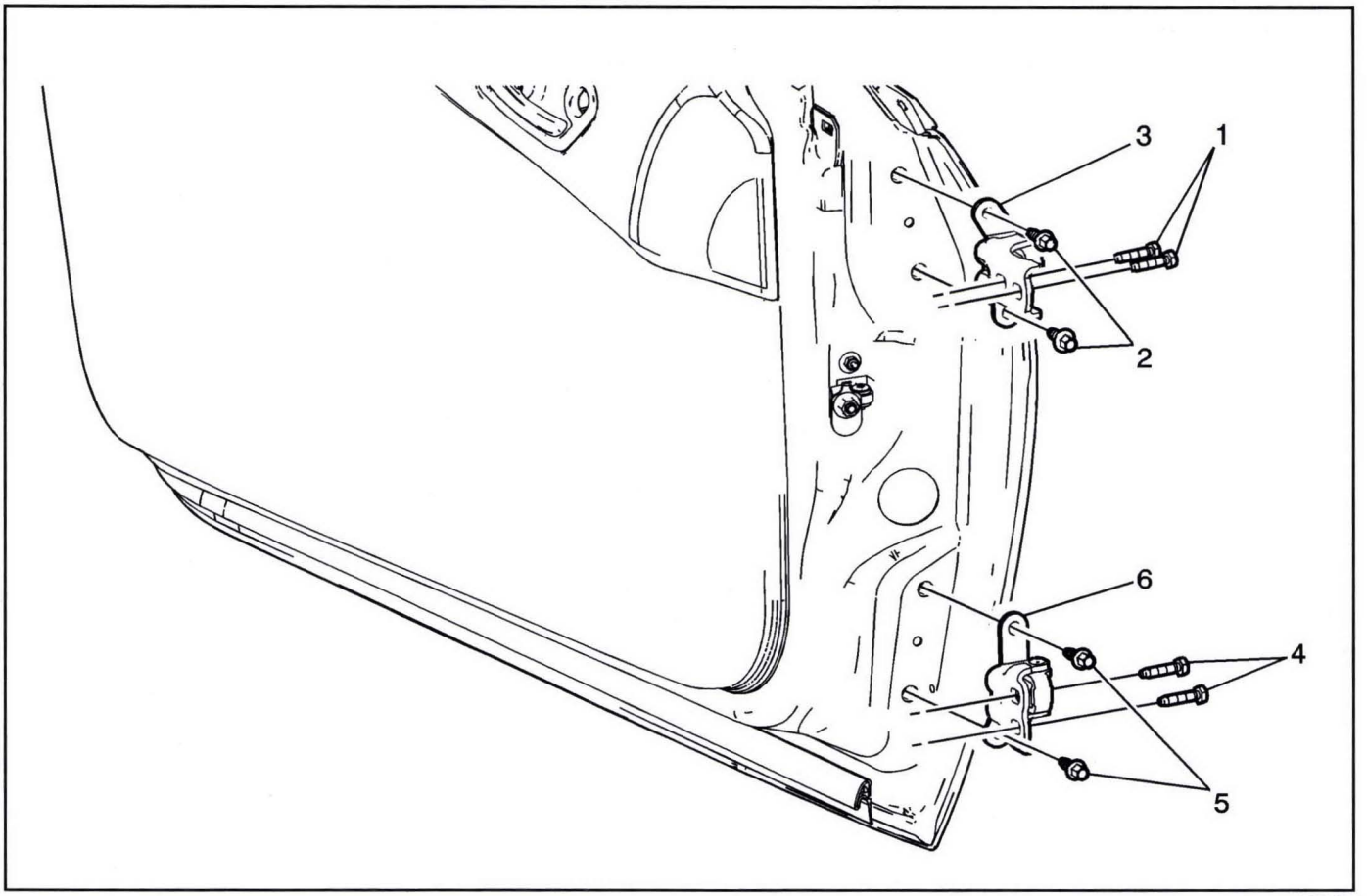


2788401

Hood Primary Latch Release Cable Handle Replacement

Callout	Component Name
1	Hood Primary Latch Release Cable Handle **Procedure** 1. Press the release cable handle downward and pull outward to release the retainers from the instrument panel bracket. 2. Disconnect the hood release cable from the hood release handle.

Front Side Door Upper Hinge and Lower Hinge Replacement



1563330

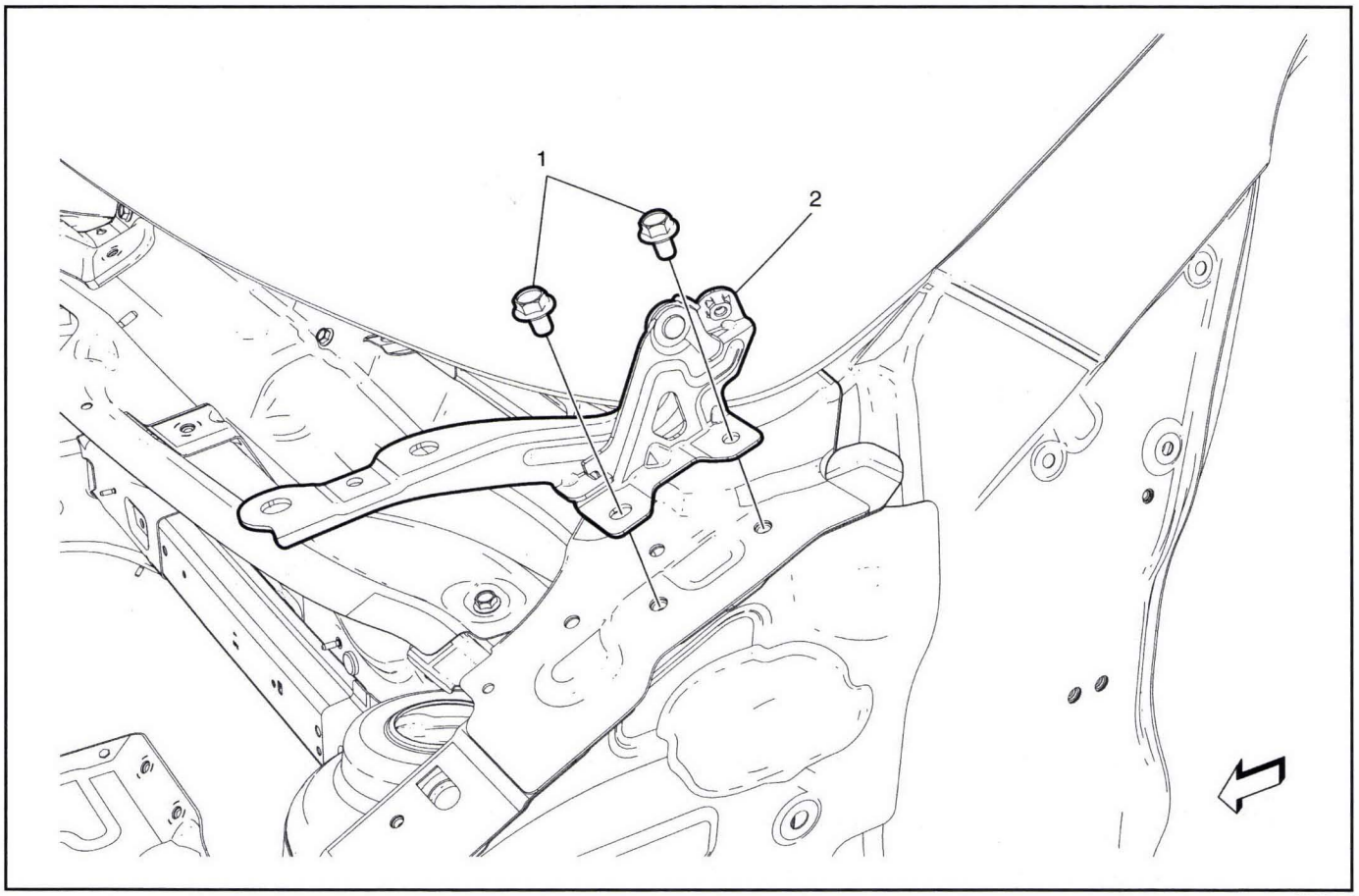
Front Side Door Upper Hinge and Lower Hinge Replacement

Callout	Component Name
1	Front Side Door Upper Hinge to Body Bolt (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*. **Procedures** 1. Before removing the door, apply a double layer of masking tape around the perimeter of the painted surfaces. 2. Mark the location of the hinge being removed. 3. Remove the front wheelhouse liner. Refer to *Front Wheelhouse Liner Replacement - Right Side on page 3-138* or *Front Wheelhouse Liner Replacement - Left Side on page 3-139*. 4. Support the door before removing the hinge bolts. **Tighten** 30 N•m (22 lb ft)
2	Front Side Door Upper Hinge to Door Bolt (Qty: 2) **Tighten** 25 N•m (18 lb ft)

Front Side Door Upper Hinge and Lower Hinge Replacement (cont'd)

Callout	Component Name
3	Front Side Door Upper Hinge
4	Front Side Door Lower Hinge to Body Bolt (Qty: 2) **Tighten** 30 N•m (22 lb ft)
5	Front Side Door Lower Hinge to Door Bolt (Qty: 2) **Tighten** 25 N•m (18 lb ft)
6	Front Side Door Lower Hinge **Procedure** If the door striker needs adjust. Refer to *Front Side Door Lock Striker Adjustment on page 4-278*.

Hood Hinge Replacement

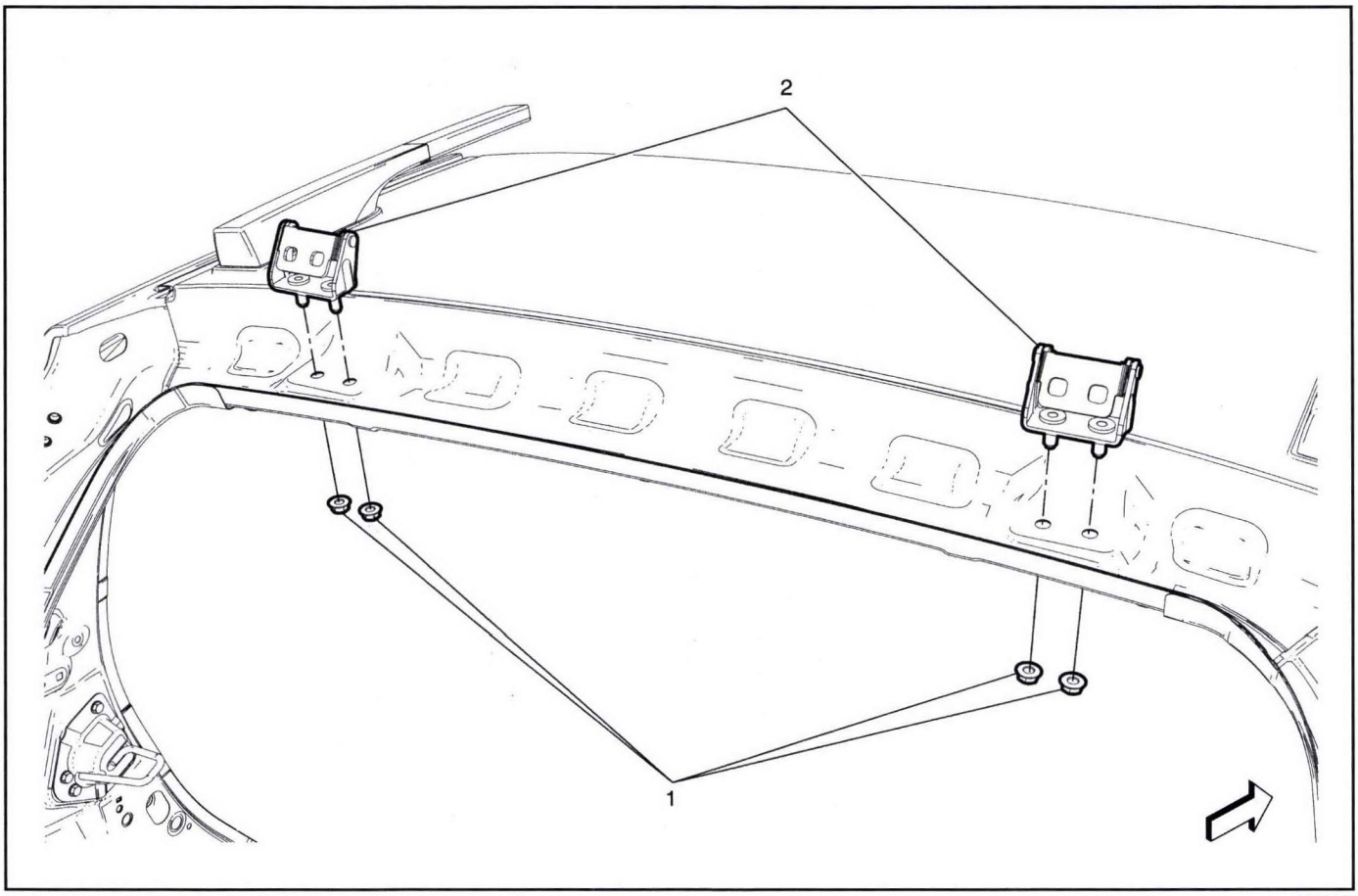


2309126

Hood Hinge Replacement

Callout	Component Name
Preliminary Procedure Remove the hood. Refer to *Hood Replacement on page 3-30*.	
1	Hood Hinge Bolt (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 18 N•m (13 lb ft)
2	Hood Hinge

Liftgate Hinge Replacement

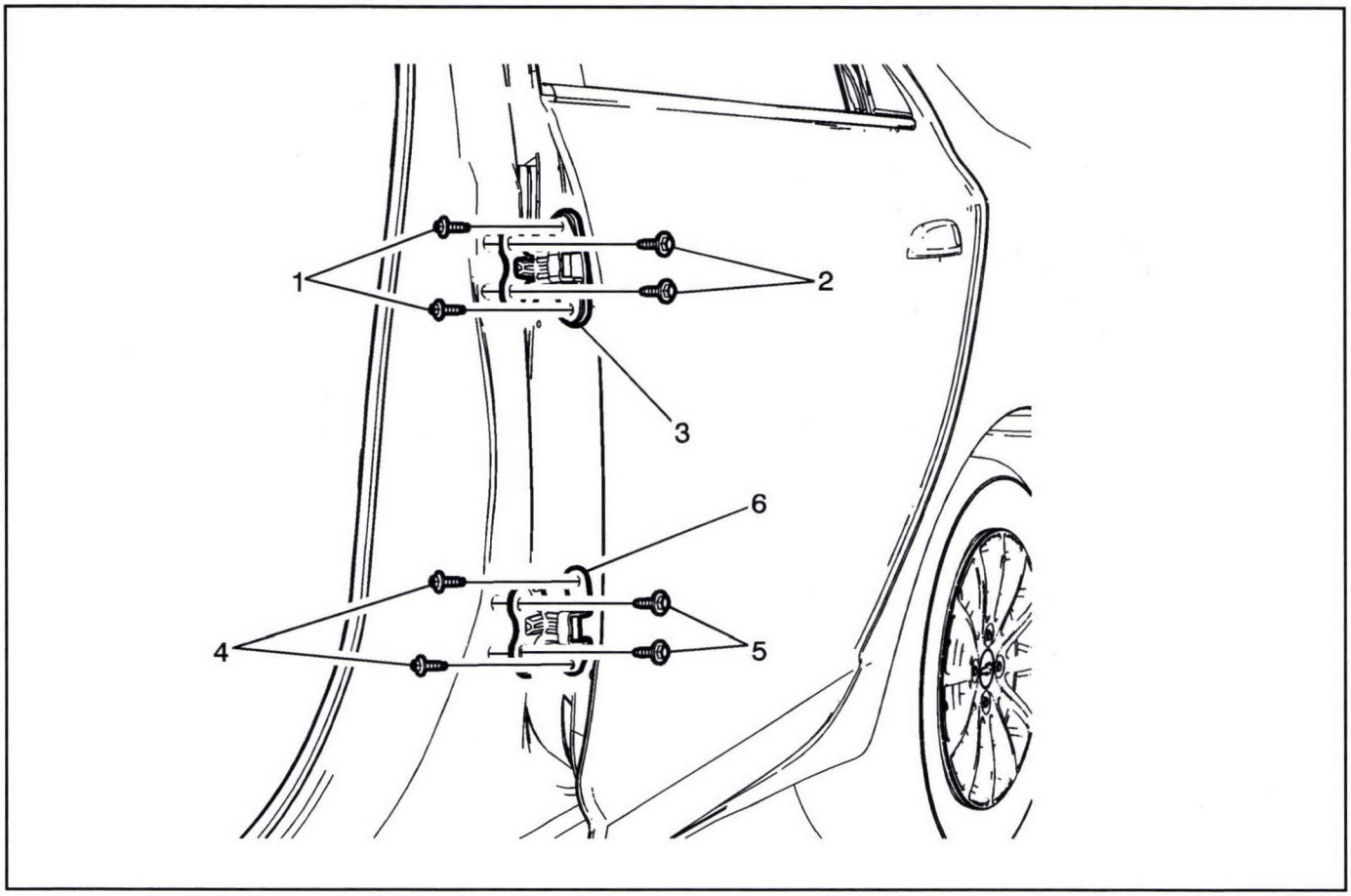


2309127

Liftgate Hinge Replacement

Callout	Component Name
Preliminary Procedure Remove the liftgate. Refer to *Liftgate Replacement on page 3-20*.	
1	Liftgate Hinge Nut (Qty: 4) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 22 N•m (16 lb ft)
2	Liftgate Hinge

Rear Side Door Upper Hinge and Lower Hinge Replacement

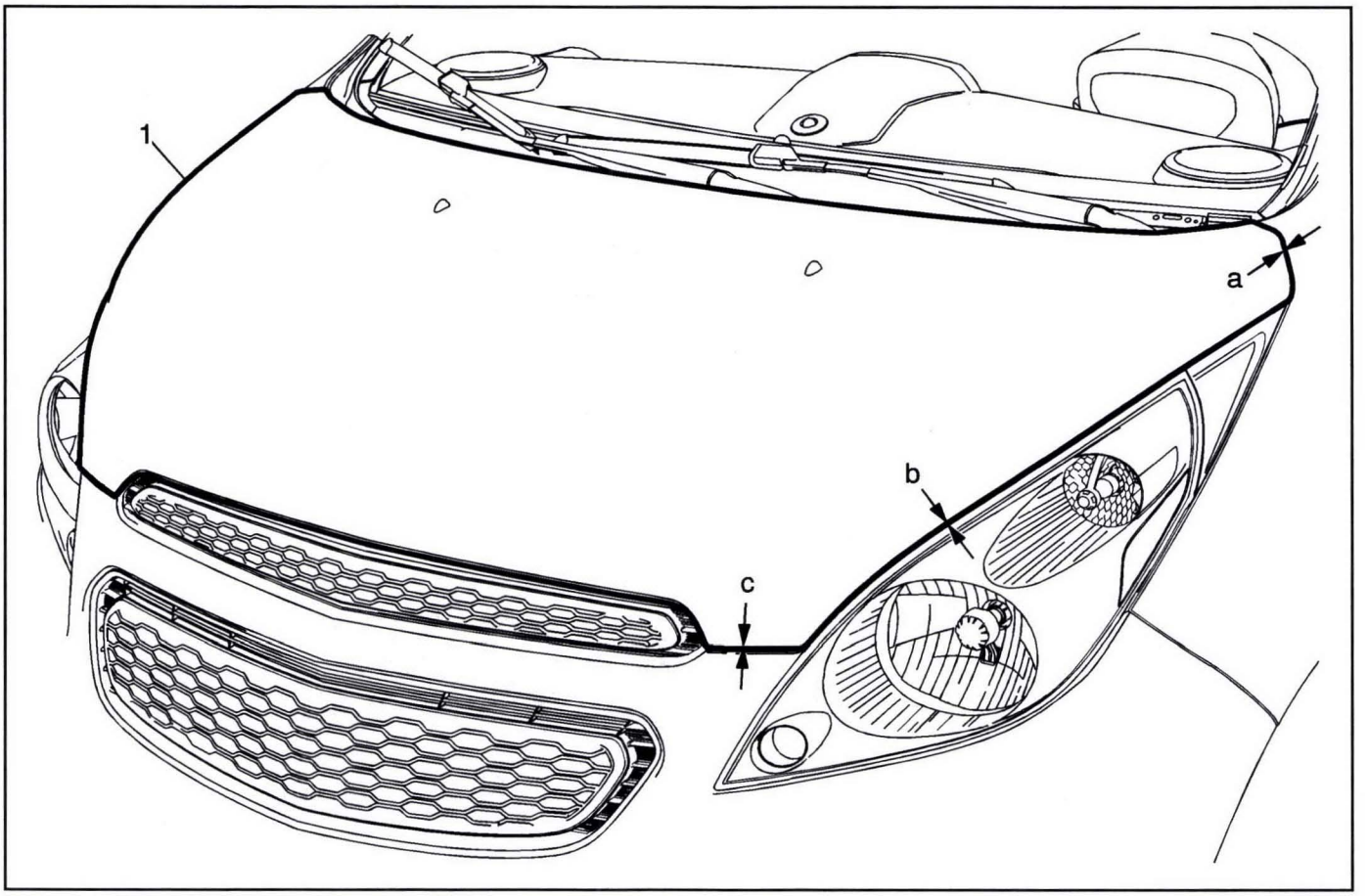


2908569

Rear Side Door Upper Hinge and Lower Hinge Replacement

Callout	Component Name
1	Rear Side Door Upper Hinge to Body Bolts (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8.* **Procedures** 1. Before removing the door, apply a double layer of masking tape around the perimeter of the painted surfaces. 2. Mark the location of the hinge being removed. 3. Support the door before removing the hinge bolts. **Tighten** 30 N•m (22 lb ft)
2	Rear Side Door Upper Hinge to Door Bolts (Qty: 2) **Tighten** 25 N•m (18 lb ft)
3	Rear Side Door Upper Hinge
4	Rear Side Door Lower Hinge to Body Bolts (Qty: 2) **Tighten** 30 N•m (22 lb ft)
5	Rear Side Door Lower Hinge to Door Bolts (Qty: 2) **Tighten** 25 N•m (18 lb ft)
6	Rear Side Door Lower Hinge **Procedure** If the door striker needs adjust. Refer to *Rear Side Door Lock Striker Adjustment on page 4-280.*

Hood Adjustment

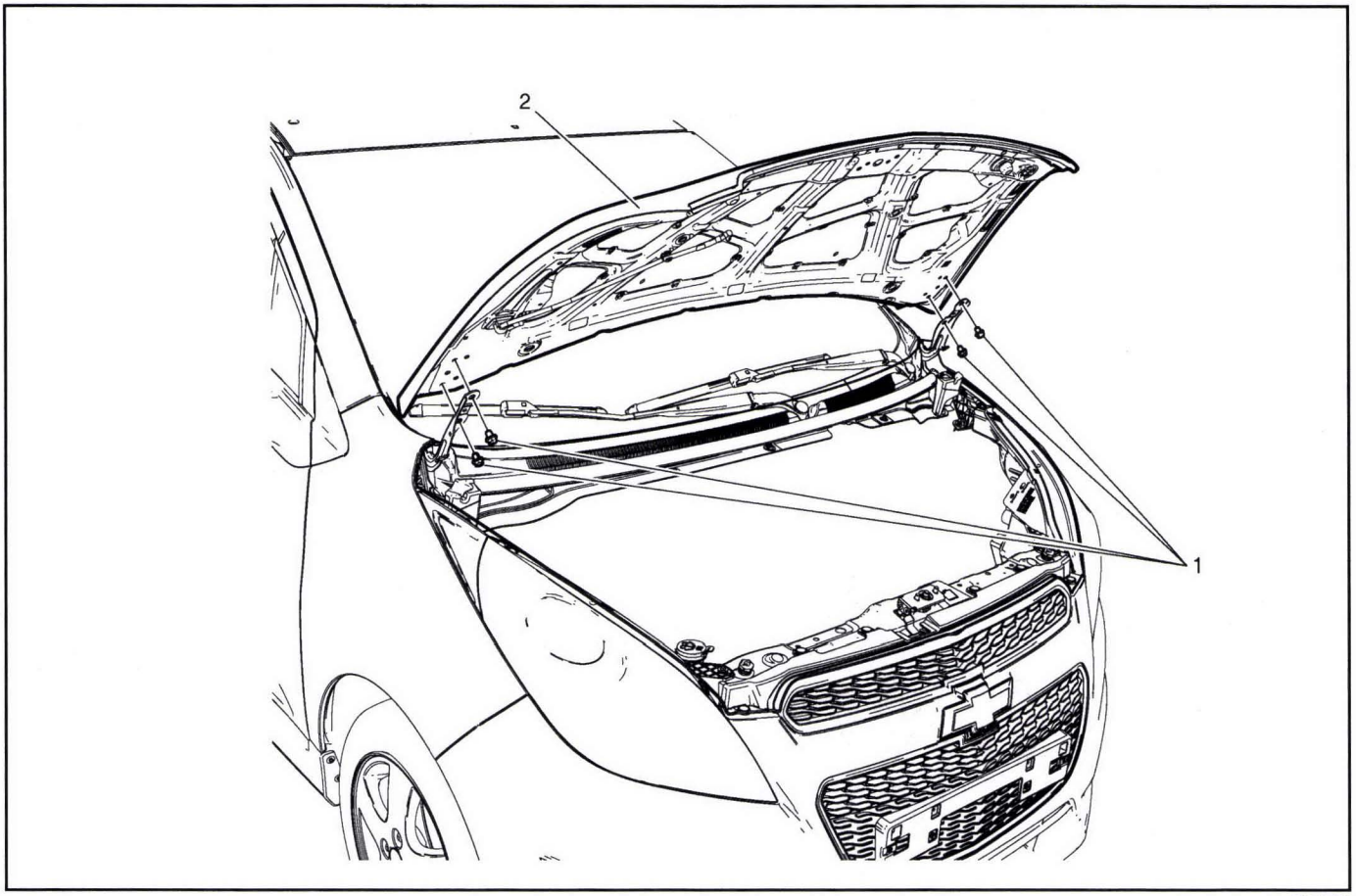


2964413

Hood Adjustment

Callout	Component Name
1	Hood **Caution:** Refer to *Fastener Caution on page 0-8*. **Procedure** 1. Loosen the 4 hood hinge nuts. 2. Adjust the hood in order to obtain an even gap on both sides between the hood and the fenders, the headlamps and the front bumper fascia and so that the hood is flush with both fenders on the front edge, the front bumper fascia and the headlamps. **Adjustment:** • Hood to front fender (a) 3.0 mm ± 0.75 mm (0.12 in ± 0.03 in) • Hood to headlamp (b) 3.0 mm ± 1.0 mm (0.12 in ± 0.04 in) • Hood to front bumper fascia (c) 5.0 mm ± 1.0 mm (0.20 in ± 0.04 in) **Tighten** 18 N•m (13 lb ft)

Hood Replacement

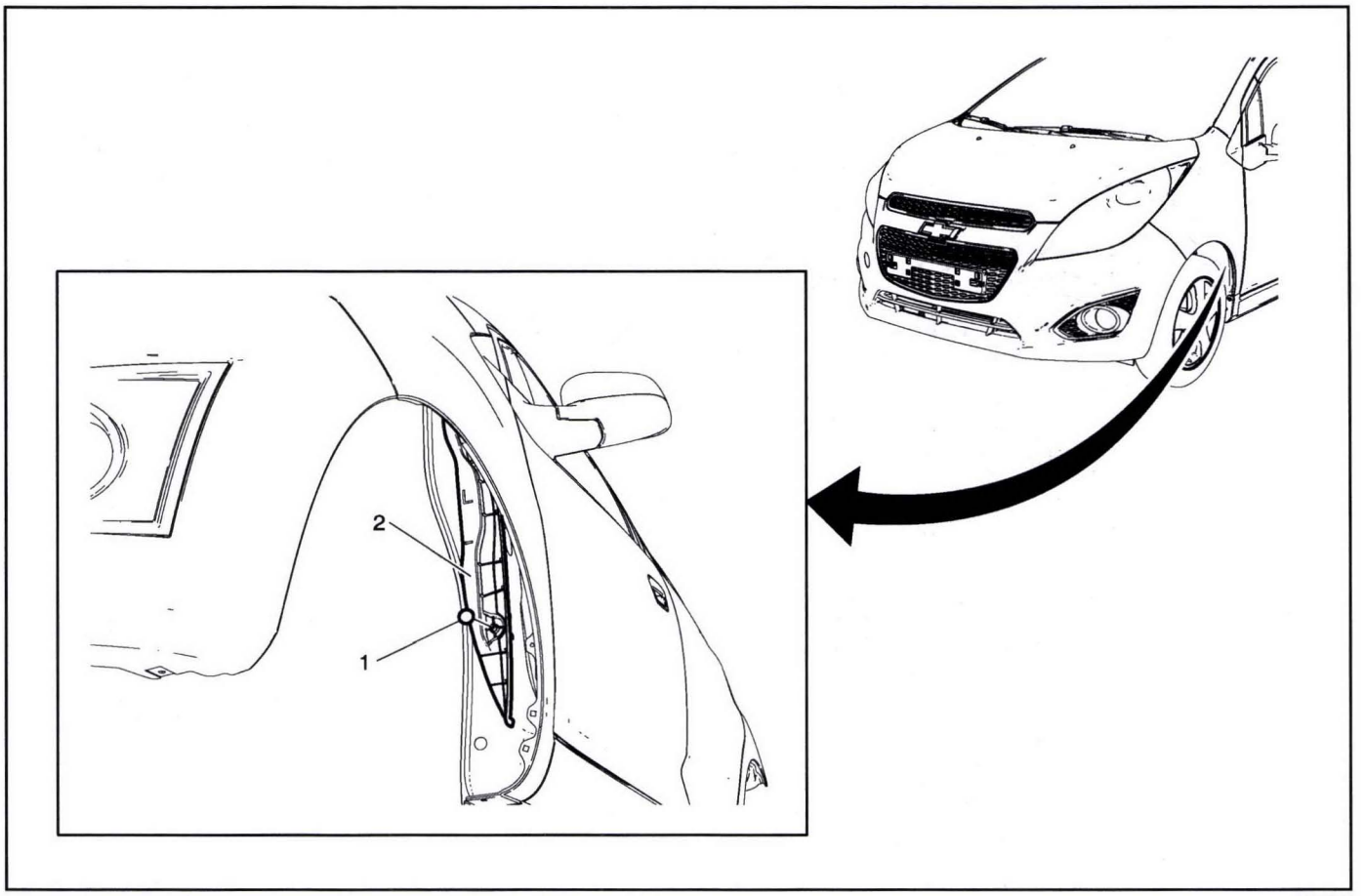


2852129

Hood Replacement

Callout	Component Name
Warning: When a hood hold open device is being removed or installed, provide alternate support to avoid the possibility of damage to the vehicle or personal injury.	
	Preliminary Procedure Remove the windshield washer nozzle hose. Refer to *Windshield Washer Nozzle Hose Replacement on page 4-320*.
1	Hood Hinge Nut (Qty: 4) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 18 N•m (13 lb ft)
2	Hood **Procedure** 1. Transfer components as necessary. 2. Adjust hood as needed. Refer to *Hood Adjustment on page 3-29*.

Front Fender Insulator Replacement

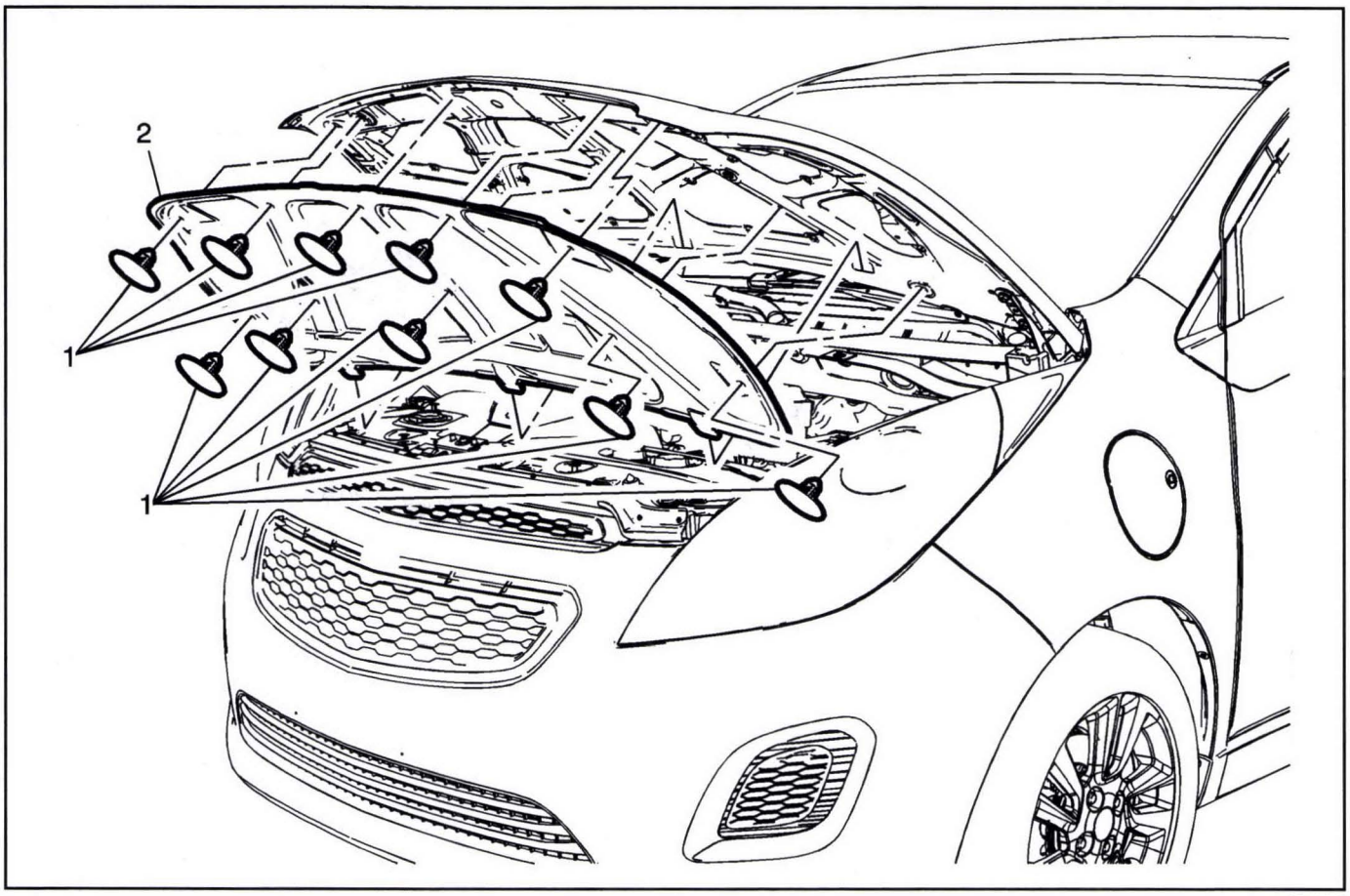


2852130

Front Fender Insulator Replacement

Callout	Component Name
Preliminary Procedure Remove the front left hand or right hand wheelhouse liner. Refer to *Front Wheelhouse Liner Replacement - Left Side on page 3-139* or *Front Wheelhouse Liner Replacement - Right Side on page 3-138*.	
1	Front Fender Insulator Retainer
2	Front Fender Insulator

Hood Insulator Replacement

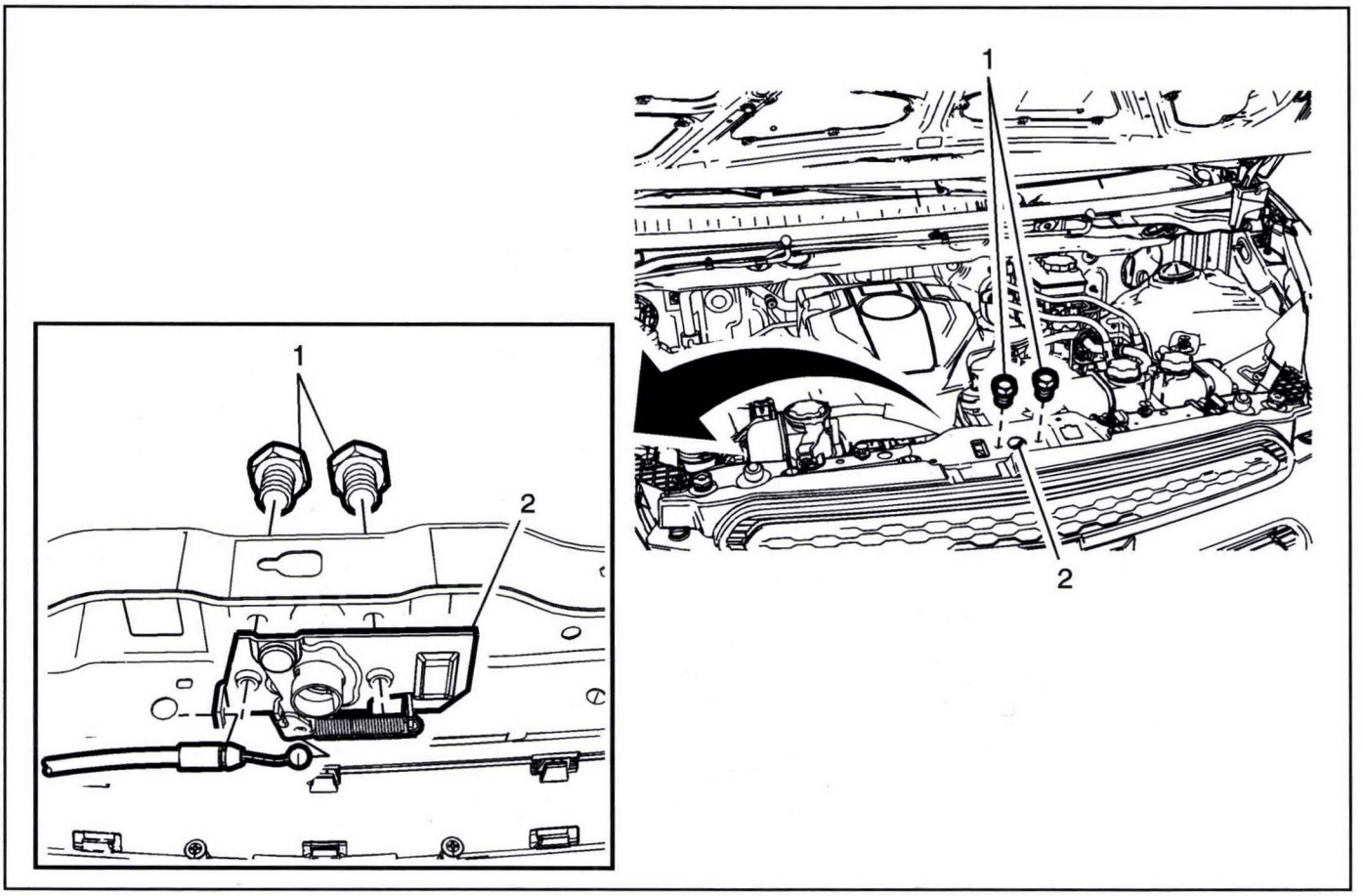


2916683

Hood Insulator Replacement

Callout	Component Name
1	Hood Insulator Plastic Retainer (Qty: 10)
2	Hood Insulator **Procedure** Ensure the 3 integral tabs are secured to the hood.

Hood Primary and Secondary Latch Replacement

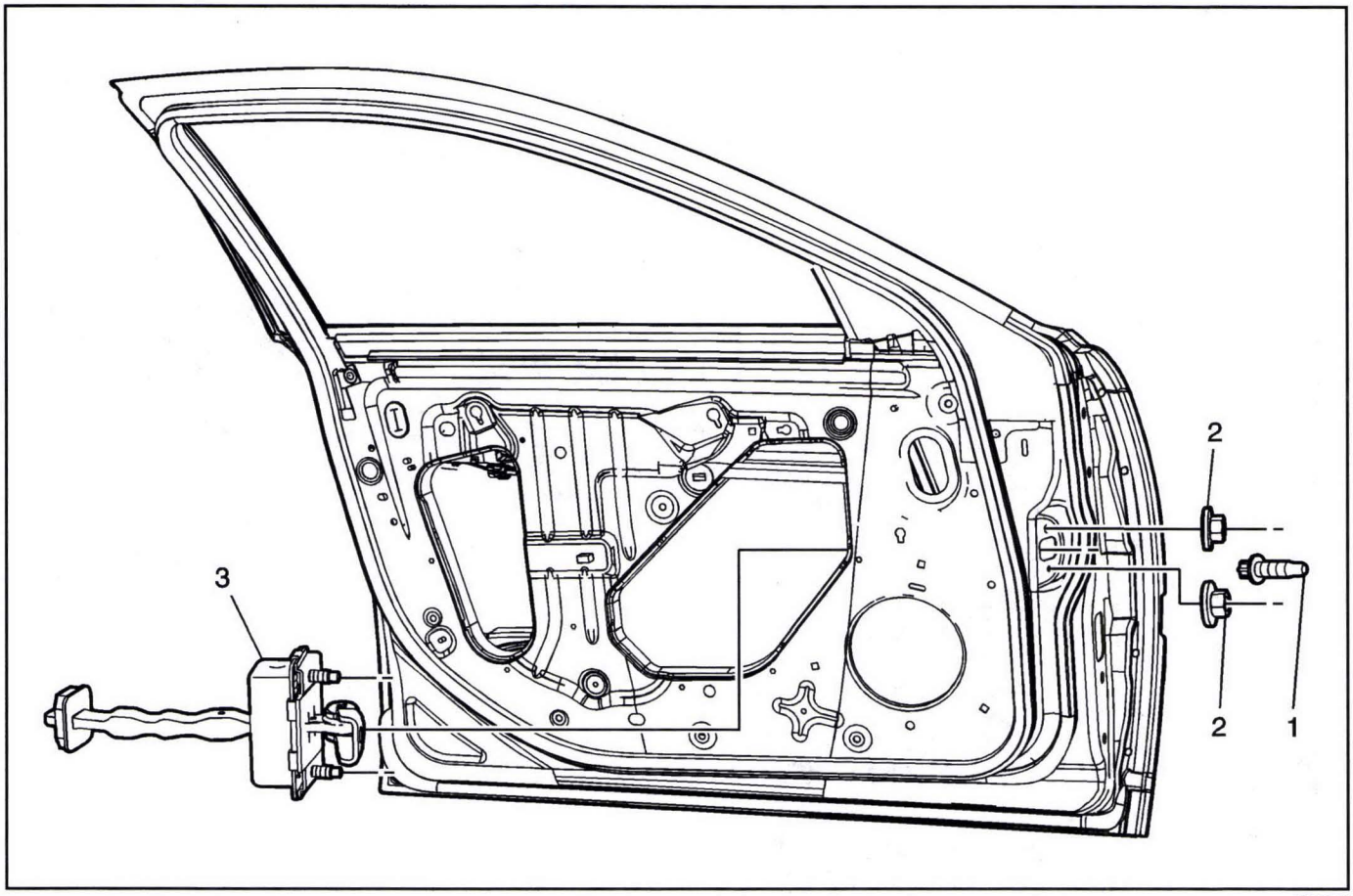


2916685

Hood Primary and Secondary Latch Replacement

Callout	Component Name
Preliminary Procedure Remove the front compartment front sight shield. Refer to *Front Compartment Front Sight Shield Replacement on page 3-39*.	
1	Hood Primary and Secondary Latch Bolt (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 8.5 N•m (75 lb in)
2	Hood Primary and Secondary Latch **Procedure** 1. Disconnect the release cable from the hood primary latch. 2. Disconnect the electrical connector, if equipped.

Front Side Door Check Link Replacement

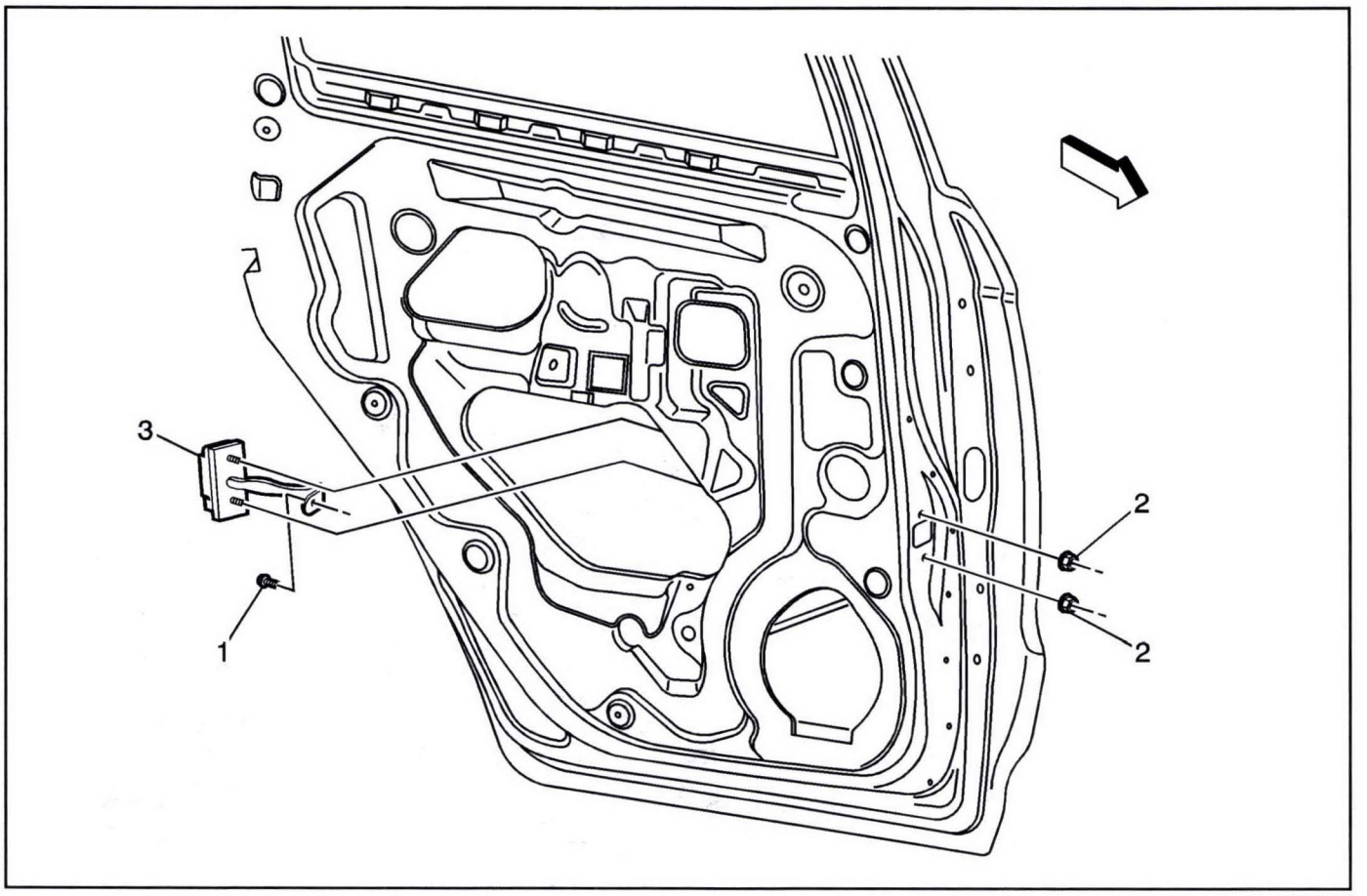


1958360

Front Side Door Check Link Replacement

Callout	Component Name
Preliminary Procedure Remove the front side door trim panel. Refer to *Front Side Door Trim Replacement on page 2-53*.	
1	Front Side Door Check Link Bolt to Body **Caution:** Refer to *Fastener Caution on page 0-8*. **Note:** Place the door window in the full open position. **Tighten** 22 N•m (16 lb ft)
2	Front Side Door Check Link Nut (Qty: 2) **Procedure** Remove the water deflector. **Tighten** 9 N•m (80 lb in)
3	Front Side Door Check Link

Rear Side Door Check Link Replacement

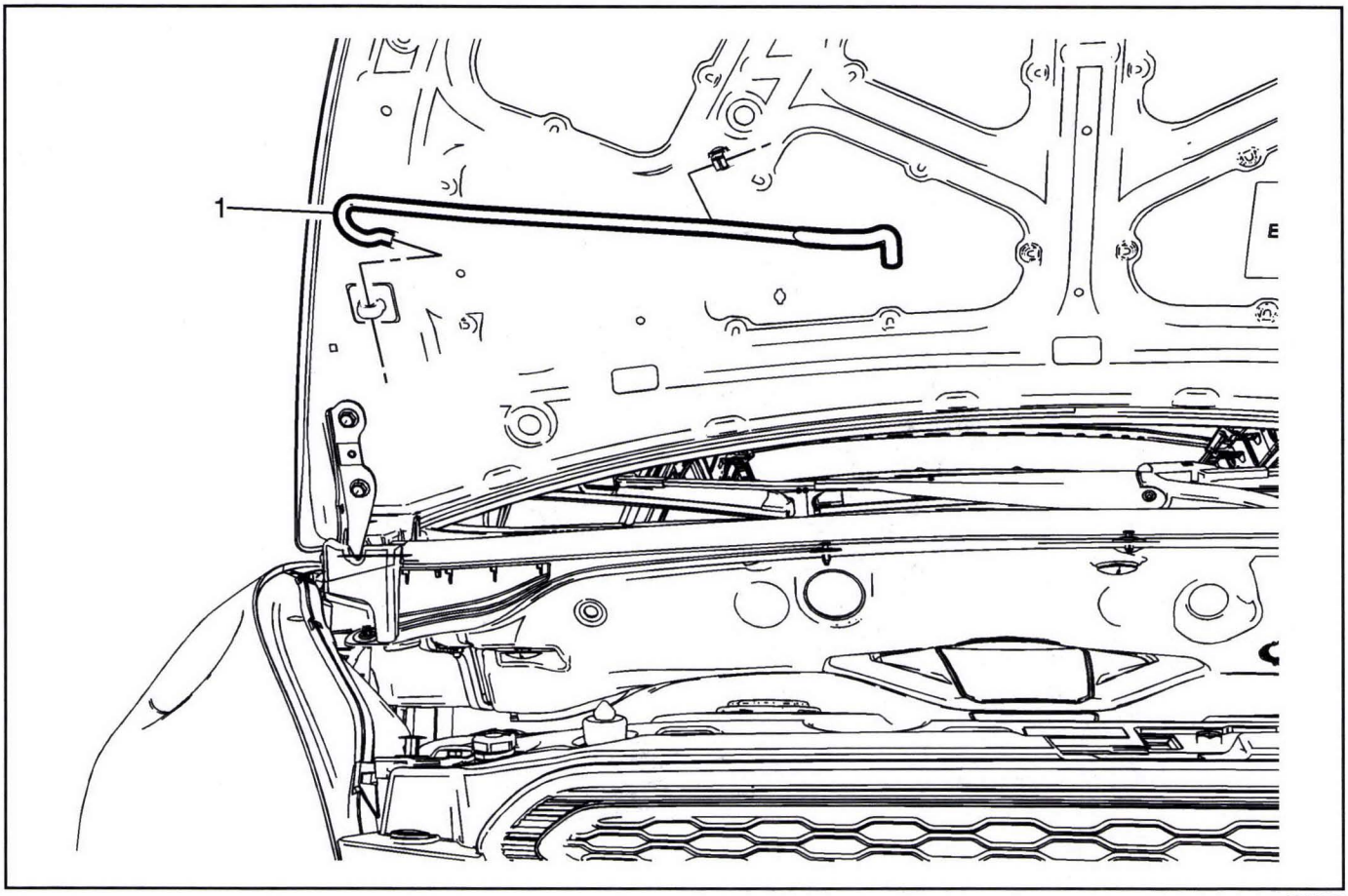


2218049

Rear Side Door Check Link Replacement

Callout	Component Name
Preliminary Procedures 1. Move the window to the full up position. 2. Remove the rear side door trim panel. Refer to *Rear Side Door Trim Replacement on page 2-68*	
1	Rear Side Door Check Link Bolt to Body **Caution:** Refer to *Fastener Caution on page 0-8* **Tighten** 22 N•m (16 lb ft)
2	Rear Side Door Check Link Nut (Qty: 2) **Procedure** Remove the water deflector. **Tighten** 9 N•m (80 lb in)
3	Rear Side Door Check Link Assembly

Hood Hold-Open Rod Replacement

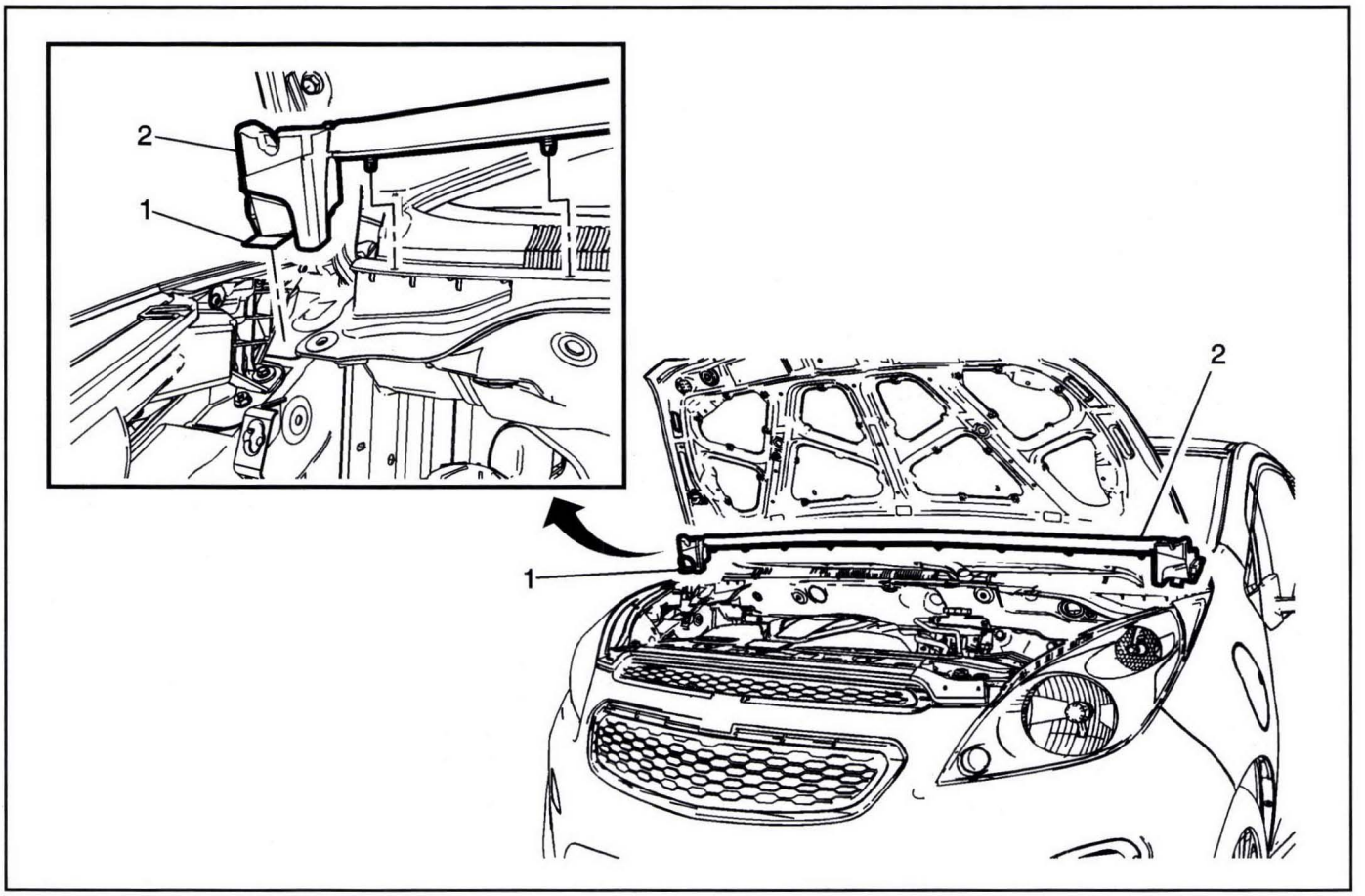


2916686

Hood Hold-Open Rod Replacement

Callout	Component Name
1	Hood Hold-Open Rod ***Warning: When a hood hold open device is being removed or installed, provide alternate support to avoid the possibility of damage to the vehicle or personal injury.*** **Procedure** Remove the hood hold-open rod by looping the rod through the hood hold-open rod retainer.

Hood Rear Weatherstrip Replacement

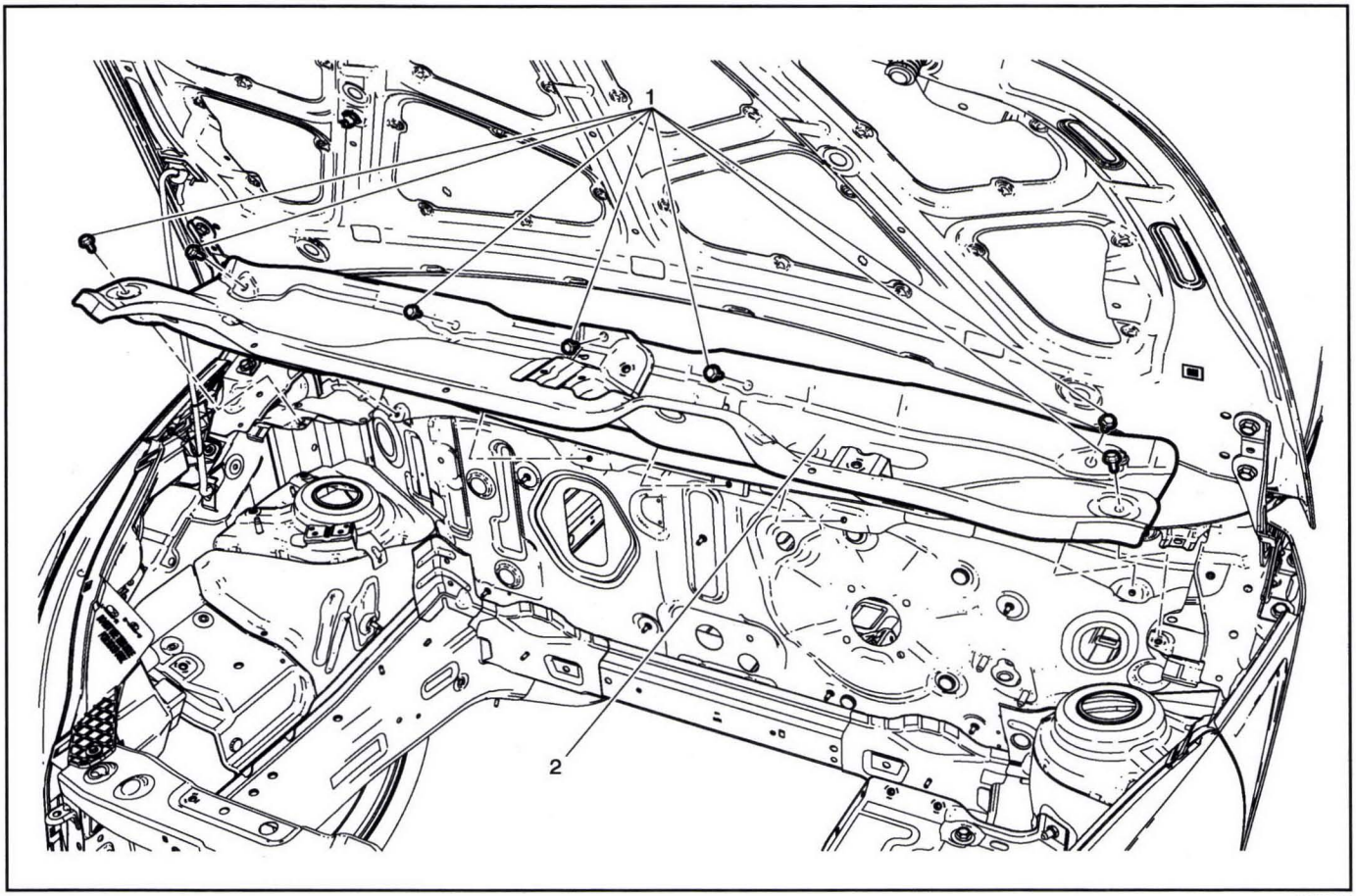


2921418

Hood Rear Weatherstrip Replacement

Callout	Component Name
1	Hood Rear Weatherstrip Removal **Procedure** Carefully pull the weatherstrip to the right/left to release from the retainers on the air inlet grille.
2	Hood Rear Weatherstrip Installation **Procedure** Clean the area where the weatherstrip end will be mounted. Use a suitable solvent with a mixture of 50 percent isopropyl alcohol and 50 percent water by volume, or high flash naphtha.

Plenum Front Panel Replacement

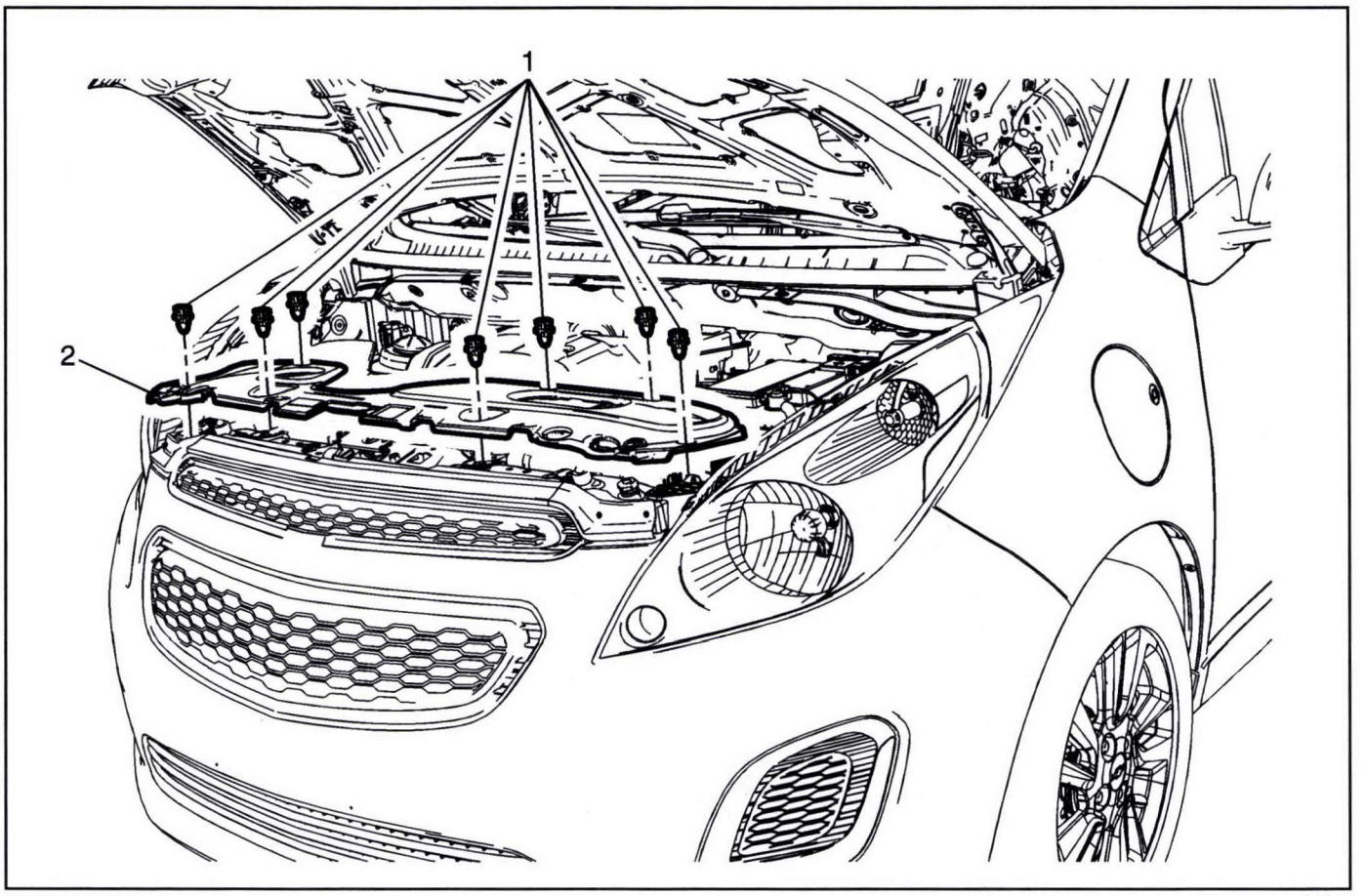


2327731

Plenum Front Panel Replacement

Callout	Component Name
Preliminary Procedure 1. Remove the windshield wiper arm. Refer to *Windshield Wiper Arm Replacement on page 4-328*. 2. Remove the air inlet grille panel. Refer to *Air Inlet Grille Panel Replacement on page 4-327*. 3. Remove the windshield wiper system module. Refer to *Windshield Wiper System Module Replacement on page 4-334*.	
1	Plenum Lower Panel Bolt (Qty: 7) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 11.5 N•m (102 lb in)
2	Plenum Lower Panel

Front Compartment Front Sight Shield Replacement

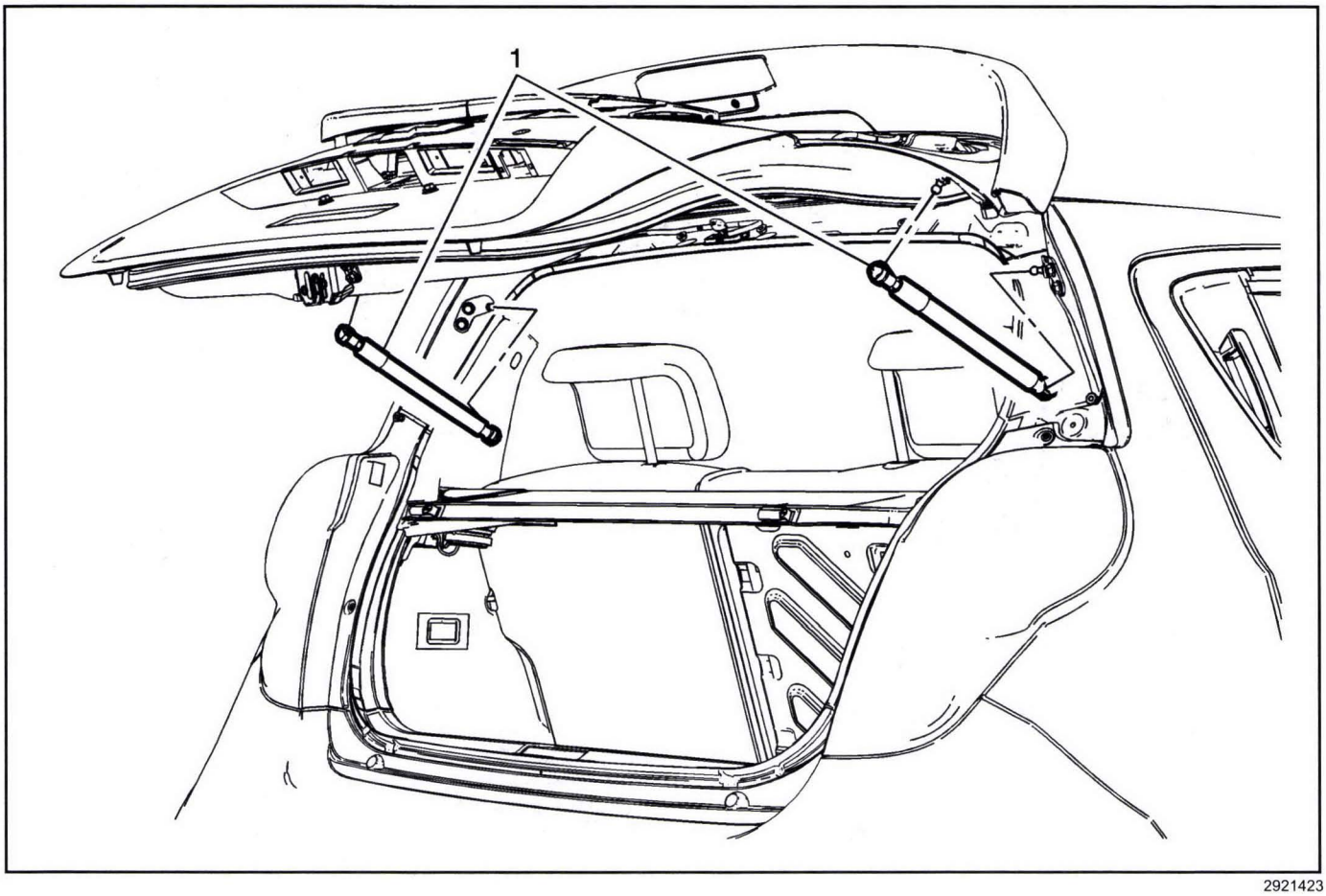


2916682

Front Compartment Front Sight Shield Replacement

Callout	Component Name
1	Front Compartment Front Sight Shield Push-In Retainer (Qty: 7)
2	Front Compartment Front Sight Shield

Liftgate Strut Replacement

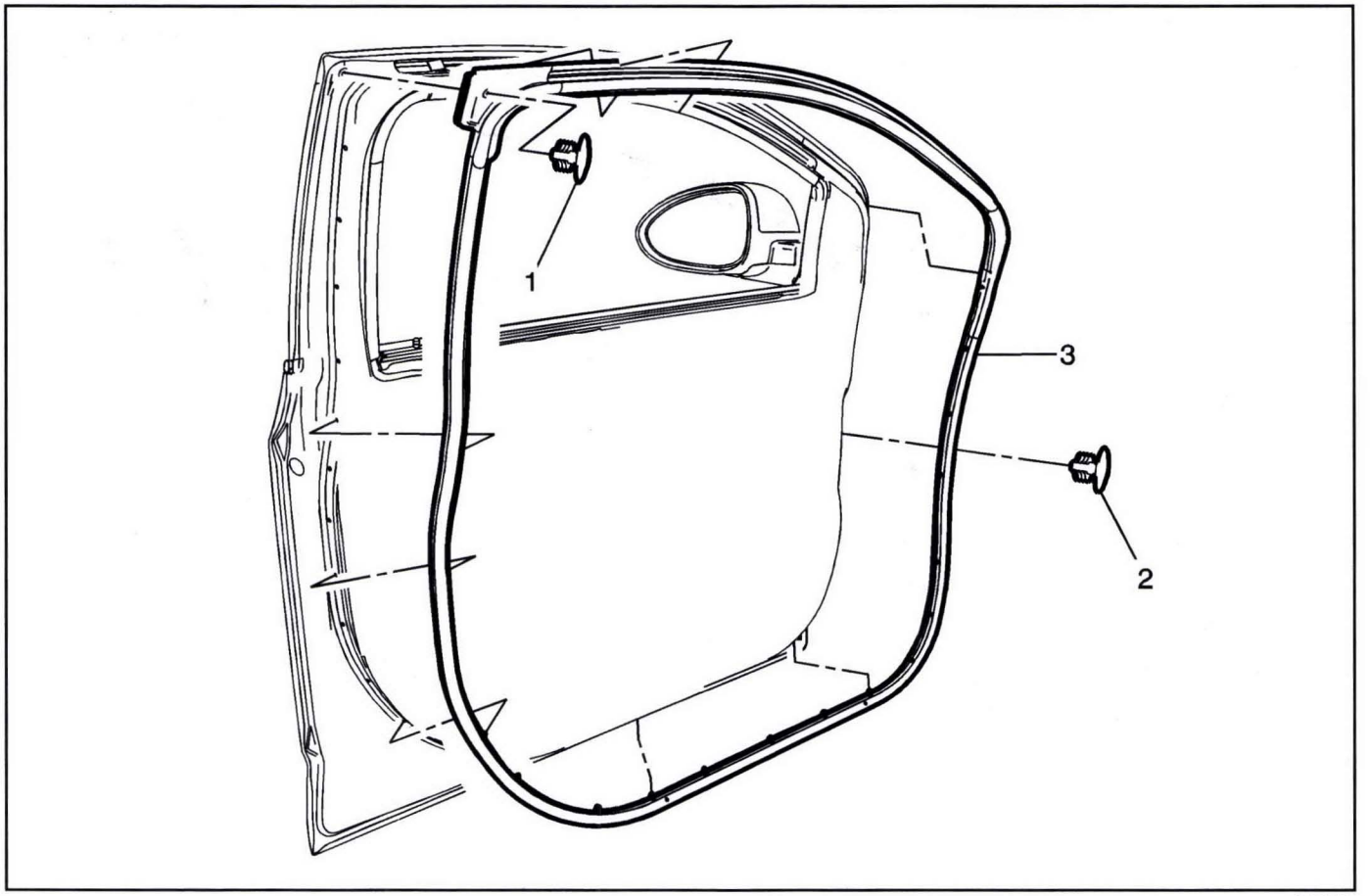


2921423

Liftgate Strut Replacement

Callout	Component Name
1	Liftgate Strut (Qty 2) ***Warning: When a lift gate hold open device is being removed or installed, provide alternate support to avoid the possibility of damage to the vehicle or personal injury.*** **Caution:** Apply pressure only at the end of the liftgate/hood assist rod that you are removing or attaching. Do NOT apply pressure to the middle of the rod because damage or bending will result. **Procedure** 1. Release the locking tabs on the strut. 2. Ensure the clip is fully seated when the strut is reinstalled. If the clip cannot be fully seated, a new strut should be installed. 3. Ensure the strut shaft is pointing toward the roof structure.

Front Side Door Weatherstrip Replacement - Door Side

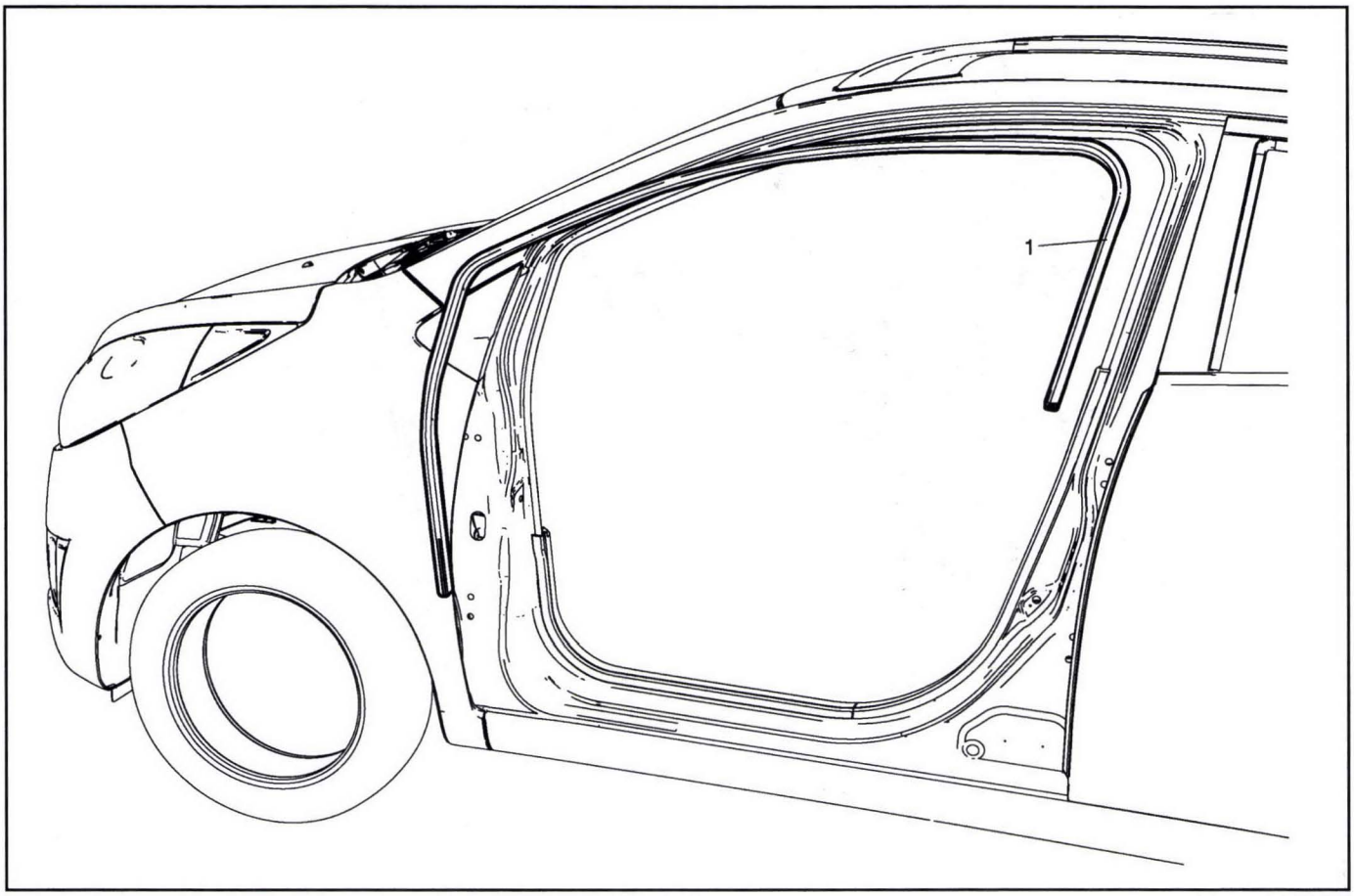


2425031

Front Side Door Weatherstrip Replacement - Door Side

Callout	Component Name
1	Front Side Door Weatherstrip Upper Retainer **Procedure** 1. Open the front side door to the fully open position. 2. Remove the front side door check link bolt from the body side only . Refer to *Front Side Door Check Link Replacement on page 3-34*. 3. Use a suitable tool, remove the push-in retainer from the upper rear corner of the door. 4. Pull the weatherstrip out of the door retainer.
2	Front Side Door Weatherstrip Retainers (Qty :21)
3	Front Side Door Weatherstrip **Procedure** 1. Ensure that the weatherstrip is fully seated in the door frame retainer. 2. Verify proper door operation.

Front Side Door Weatherstrip Replacement - Body Side

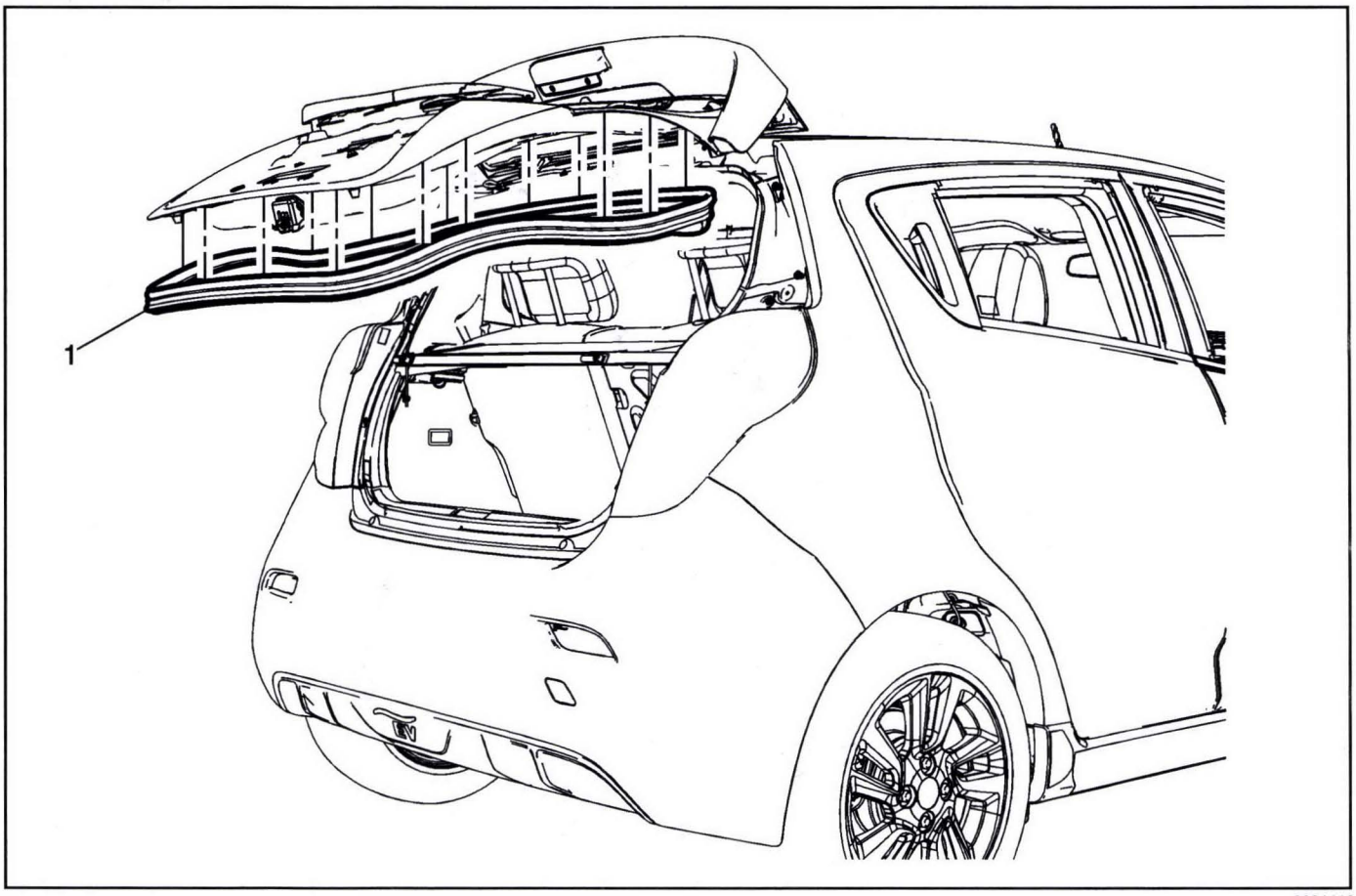


2327726

Front Side Door Weatherstrip Replacement - Body Side

Callout	Component Name
Preliminary Procedures 1. Remove the upper center pillar trim. Refer to *Center Pillar Upper Trim Panel Replacement on page 2-62*. 2. Remove the lower center pillar trim. Refer to *Center Pillar Lower Trim Panel Replacement on page 2-63* 3. Remove the front side door sill garnish molding. Refer to *Front Side Door Sill Garnish Molding Replacement on page 2-57*.	
1	Front Side Door Weatherstrip Body Side **Procedure** 1. Starting in the center bottom of the weatherstrip, pull the weatherstrip upward and away from the pinch-weld flange. 2. Start in the center bottom of the pinch-weld flange. 3. Ensure that the weatherstrip and retainers are fully seated on the flange before installing the front carpet retainer. 4. Inspect the door for proper operation.

Liftgate Weatherstrip Replacement

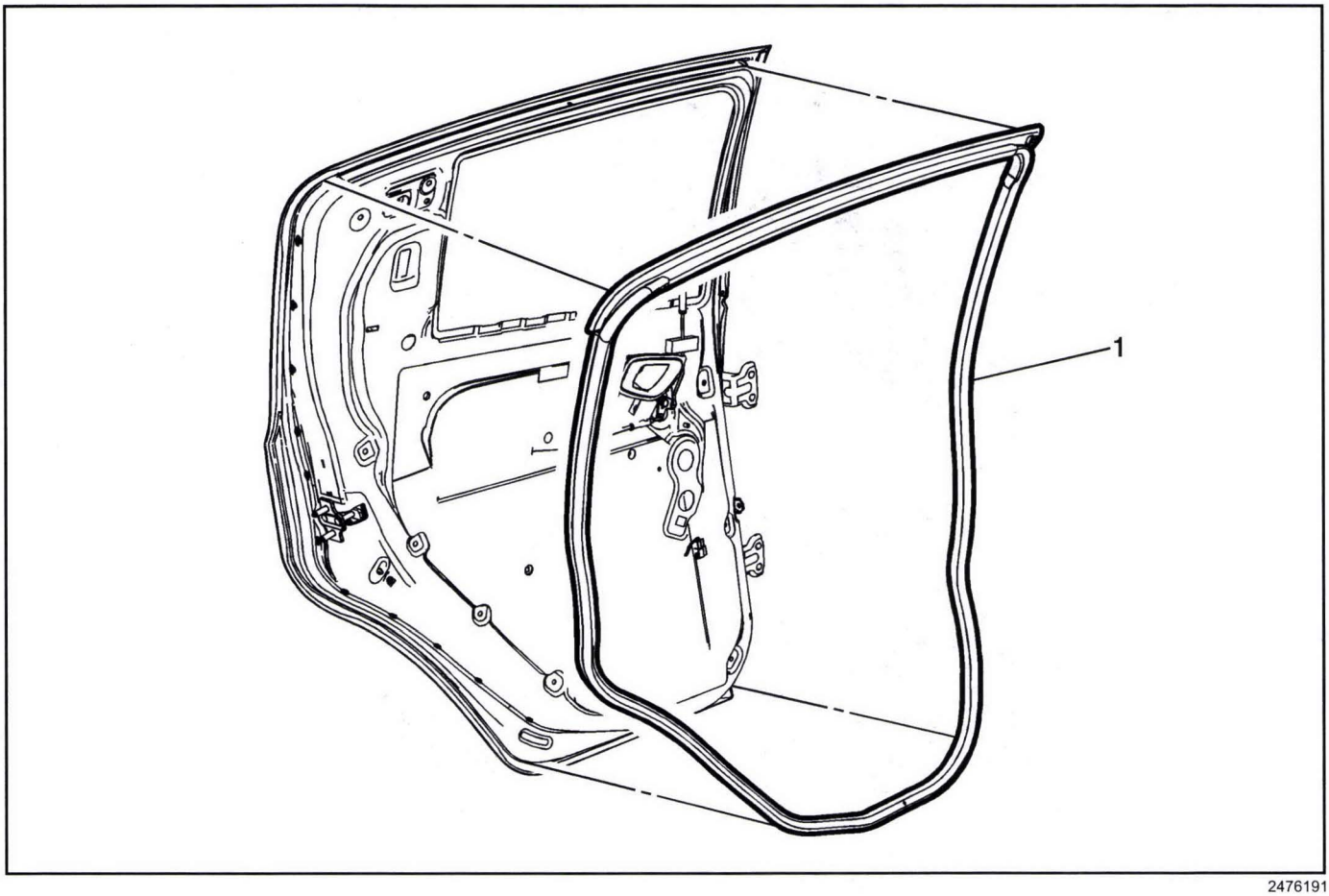


2921416

Liftgate Weatherstrip Replacement

Callout	Component Name
1	Liftgate Weatherstrip **Procedure** Clean the area where the seal will be mounted. Use a suitable solvent with a mixture of 50 percent isopropyl alcohol and 50 percent water by volume, or high-flash naphtha.

Rear Side Door Weatherstrip Replacement - Door Side

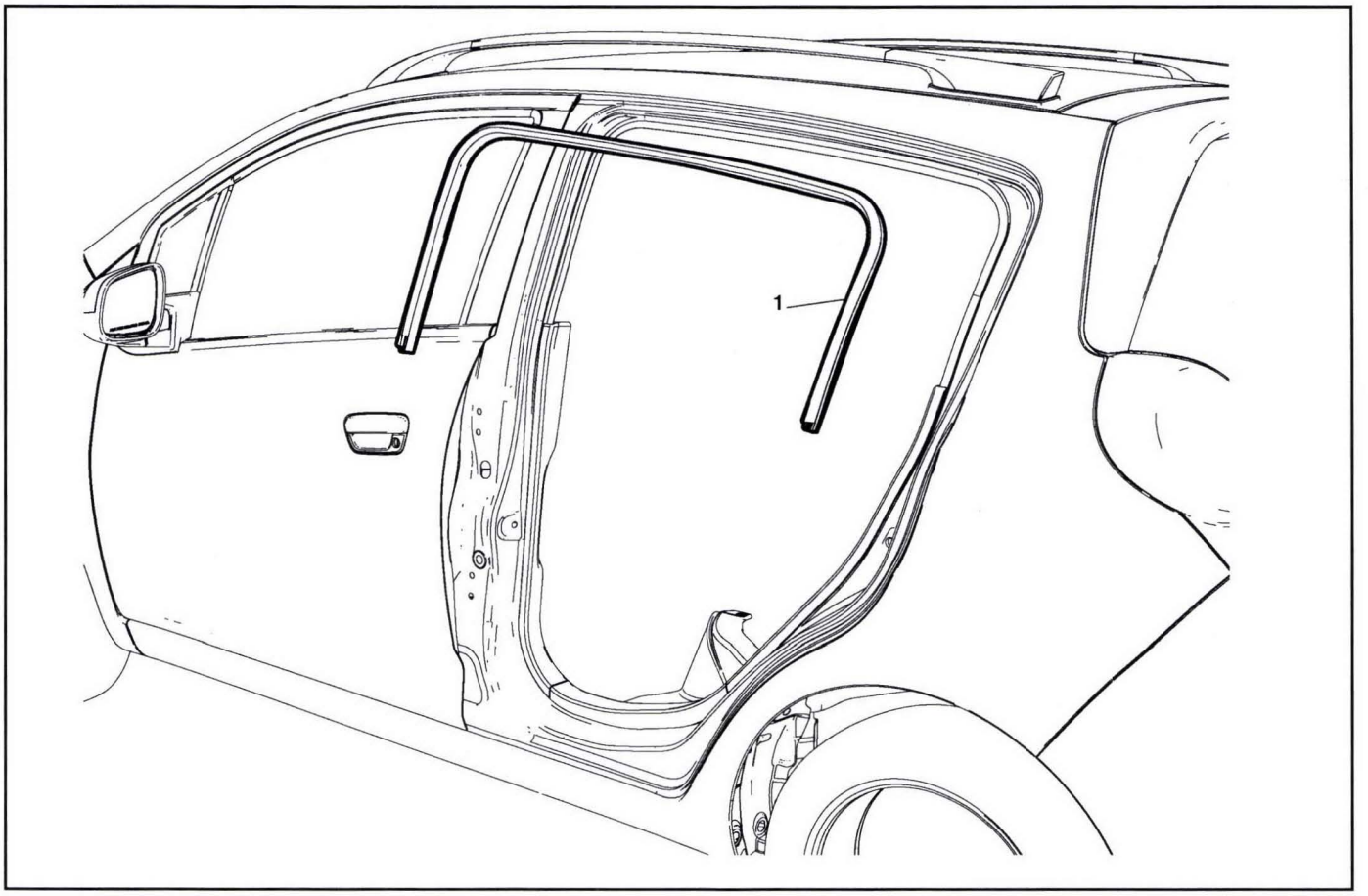


2476191

Rear Side Door Weatherstrip Replacement - Door Side

Callout	Component Name
1	Rear Side Door Weatherstrip **Procedure** 1. Open the front side door to the fully open position. 2. Remove the front side door check link bolt from the body side only . Refer to *Front Side Door Check Link Replacement on page 3-34*. 3. Use a suitable tool, remove the push-in retainers from the corners of the door. 4. Pull the weatherstrip out of the door retainer. 5. Ensure that the weatherstrip is fully seated in the door frame retainer. 6. Verify proper door operation.

Rear Side Door Weatherstrip Replacement - Body Side



2327723

Rear Side Door Weatherstrip Replacement - Body Side

Callout	Component Name
Preliminary Procedures 1. Remove the upper center pillar trim. Refer to *Center Pillar Upper Trim Panel Replacement on page 2-62*. 2. Remove the lower center pillar trim. Refer to *Center Pillar Lower Trim Panel Replacement on page 2-63*. 3. Remove the rear side door sill garnish molding. Refer to *Rear Side Door Sill Garnish Molding Replacement on page 2-58*.	
1	Rear Side Door Weatherstrip Body Side **Procedure** 1. Starting in the center bottom of the weatherstrip, pull the weatherstrip upward and away from the pinch-weld flange. 2. Start in the center bottom of the pinch-weld flange. 3. Ensure that the weatherstrip and retainers are fully seated on the flange before installing the front carpet retainer. 4. Inspect the door for proper operation.

Description and Operation

Hood Ajar Indicator Description and Operation

Hood Ajar Switch

The body control module (BCM) applies B+ to the hood ajar signal circuit and monitors the voltage to determine the position of the hood. When the hood is closed, the switch is open and voltage remains high. When the hood is open, the switch is closed and the voltage is pulled low.

The BCM uses the hood ajar switch as a content theft deterrent alarm trigger.

Bumpers and Fascias

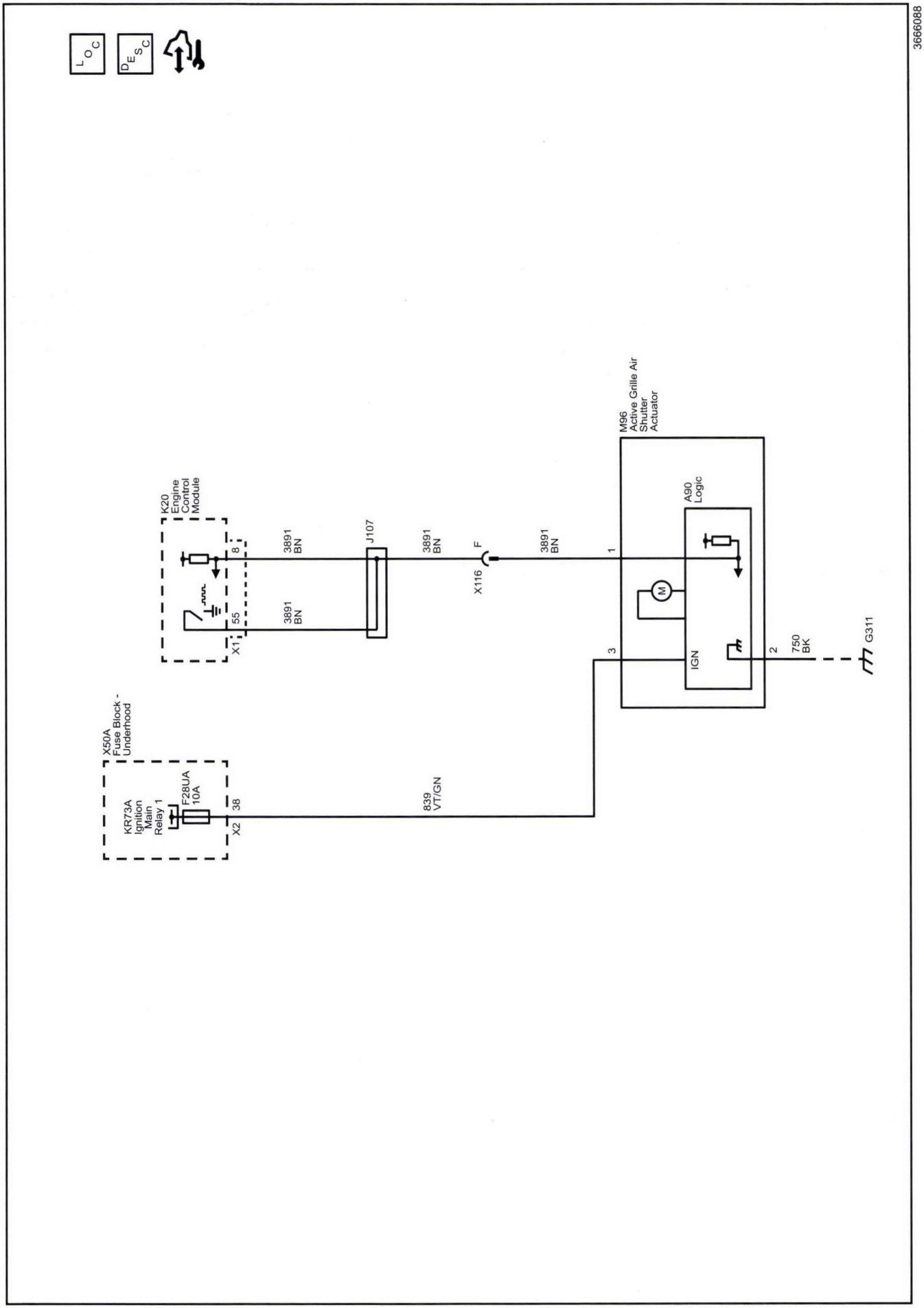
Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Front Bumper Fascia Opening Cover Bolt	1.5 N•m	13 lb in
Front Bumper Fascia Opening Lower Cover Bolt	9.5 N•m	84 lb in
Front Bumper Fascia Screw	1.8 N•m	16 lb in
Front Bumper Fascia Side Bracket Screw	2.5 N•m	22 lb in
Front Bumper Impact Bar Bolt	22 N•m	16 lb ft
Front Bumper Lower Impact Bar Bolt	22 N•m	16 lb ft
Front Bumper Lower Shutter Bolt	1.5 N•m	13 lb in
Rear Bumper Fascia Screw	1.8 N•m	16 lb in
Rear Bumper Impact Bar Nut	22 N•m	16 lb ft
Rear Bumper Lower Fascia Bolt	2.5 N•m	22 lb in
Rear Bumper Lower Fascia Screw	1.5 N•m	13 lb in

Schematic and Routing Diagrams

Active Grille Air Shutter Schematics (Active Grille Air Shutter)



Diagnostic Information and Procedures

DTC P059F or P151E

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC P059F: Active Grille Air Shutter 1 Performance

DTC P151E: Active Grille Air Shutter Actuator 1 Signal Message Counter Incorrect

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P059F, P151E	P059F, P151E	—	—
Control – Terminal 8	P059F, P151E	P059F, P151E	P059F, P151E	P059F, P151E
Control – Terminal 55	P059F, P151E	P059F, P151E	P059F, P151E	P059F, P151E
Ground	—	P059F, P151E	—	—

Circuit/System Description

The active grille air shutter actuator closes louvers at the front bumper to enhance vehicle aerodynamics in driving situations where cooling and A/C loads are relatively low and high levels of front end airflow are not required. If high levels of airflow are required the active grille air shutter actuator opens the louvers. The control signal from the engine control module, ignition and ground circuits enable the active grille air shutter actuator to operate. If the conditions for opening the louvers are reached the engine control module commands the active grille air shutter actuator to open the louvers.

Conditions for Running the DTC

- The Vehicle is ON.
- The battery voltage is greater than 10 V.
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

- The DTC P059F will be set during a key cycle when the commanded louver position can not be achieved after 3 attempts are made to move the louver. The DTC will be stored as current for this key cycle but the malfunction indicator lamp (MIL) will not be illuminated.
- On the next key cycle the louver will be commanded to move again. If the commanded louver position can not be achieved after 3 more attempts, the MIL will be illuminated and DTC P059F will be set as current.
- The DTC P151E will set if there is no communication on the bi-directional control circuit.

Action Taken When the DTC Sets

DTC P059F and P151E are type B DTCs.

Conditions for Clearing the DTC

DTC P059F and P151E are type B DTCs.

Reference Information

Schematic Reference

Active Grille Air Shutter Schematics on page 3-48

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Active Grille Air Shutter Description and Operation on page 3-67

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U0109 is not set.

⇒ **If DTC U0109 is set**

Refer to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92* for further diagnosis.

⇓ **If DTC U0109 is not set**

3. Verify the active grille air shutter actuator opens and closes the louvers at the front bumper when performing the Active Grille Air Shutter System test with a scan tool.

⇒ **If the louvers at the front bumper do not open and close and the test result is fail**

Refer to Circuit/System Testing.

⇓ **If the louvers at the front bumper open and close and the test result is pass**

4. Verify none of the following conditions are present:
   - Snow or ice packed in the front fascia which prevents the louvers from moving.
   - Debris or foreign objects which prevent the louvers from moving.

⇒ **If any of the conditions are present**

Clear any snow, ice or foreign objects from the front grille.

⇓ **If none of the conditions are present**

5. All OK

Circuit/System Testing

1. Vehicle OFF, and all vehicle systems OFF, disconnect the harness connector at the M96 Active Grille Air Shutter Actuator. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the ignition circuit terminal 3 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

4.1. Vehicle OFF.

4.2. Test for less than 2 Ω in the ignition circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse. Refer to *Power Mode Mismatch on page 11-857*.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

4.1. Vehicle OFF.

4.2. Test for infinite resistance between the ignition circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the M96 Active Grille Air Shutter Actuator.

⇓ **If the test lamp illuminates**

5. Connect a test lamp between the control circuit terminal 1 and the ignition circuit terminal 3.
6. Verify the test lamp turns On and Off when performing the Active Grille Air Shutter System test with a scan tool.

⇒ **If the test lamp is always Off**

6.1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, Vehicle ON.

6.2. Test for less than 1 V between the control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Vehicle OFF.

6.4. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K20 Engine Control Module.

⇒ **If the test lamp is always On**

6.1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

6.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K20 Engine Control Module.

⇓ **If the test lamp turns On and Off**

7. Vehicle OFF, connector the harness connector at the M96 Active Grille Air Shutter Actuator. Disconnect the harness connector at the K20 Engine Control Module, Vehicle in Service Mode.

8. Test for greater than 11 V between the control circuit terminal 8 and ground.

⇒ **If 11 V or less**

8.1. Vehicle OFF, disconnect the harness connector at the M96 Active Grille Air Shutter Actuator.

8.2. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the M96 Active Grille Air Shutter Actuator.

⇓ **If greater than 11 V**

9. Test or replace the M96 Active Grille Air Shutter Actuator.
10. Verify DTC U0284 is not set.

⇒ **If the DTC is set**

Replace the K20 Engine Control Module.

⇓ **If the DTC is not set**

11. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for engine control module replacement, programming and setup.

Symptoms - Active Grille Air Shutter

Note: The following steps must be completed before using the symptom tables:

1. Perform the *Diagnostic System Check - Vehicle on page 6-91* before using the Symptom Tables in order to verify that all of the following are true:
   - There are no DTCs set.
   - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to *Active Grille Air Shutter Description and Operation on page 3-67*.

Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the system. Refer to *Checking Aftermarket Accessories on page 11-871*.
- Inspect the easily accessible or visible system components for obvious damage or conditions which may cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to *Testing for Intermittent Conditions and Poor Connections on page 11-877*.

Symptom List

Active Grille Air Shutter Malfunction on page 3-51

Active Grille Air Shutter Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC P059F: Active Grille Air Shutter 1 Performance

DTC P151E: Active Grille Air Shutter Actuator 1 Signal Message Counter Incorrect

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P059F, P151E	P059F, P151E	—	—
Control – Terminal 8	P059F, P151E	P059F, P151E	P059F, P151E	P059F, P151E
Control – Terminal 55	P059F, P151E	P059F, P151E	P059F, P151E	P059F, P151E
Ground	—	P059F, P151E	—	—

Circuit/System Description

The active grille air shutter actuator closes louvers at the front bumper to enhance vehicle aerodynamics in driving situations where cooling and A/C loads are relatively low and high levels of front end airflow are not required. If high levels of airflow are required the active grille air shutter actuator opens the louvers. The control signal from the engine control module, ignition and ground circuits enable the active grille air shutter actuator to operate. If the conditions for opening the louvers are reached the engine control module commands the active grille air shutter actuator to open the louvers.

Conditions for Running the DTC

- The Vehicle is ON.
- The battery voltage is greater than 10 V.
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

- The DTC P059F will be set during a key cycle when the commanded louver position can not be achieved after 3 attempts are made to move the louver. The DTC will be stored as current for this key cycle but the malfunction indicator lamp (MIL) will not be illuminated.
- On the next key cycle the louver will be commanded to move again. If the commanded louver position can not be achieved after 3 more attempts, the MIL will be illuminated and DTC P059F will be set as current.
- The DTC P151E will set if there is no communication on the bi-directional control circuit.

Action Taken When the DTC Sets

DTC P059F and P151E are type B DTCs.

Conditions for Clearing the DTC

DTC P059F and P151E are type B DTCs.

Reference Information

Schematic Reference

Active Grille Air Shutter Schematics on page 3-48

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Active Grille Air Shutter Description and Operation on page 3-67

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U0109 is not set.

⇒ **If DTC U0109 is set**

Refer to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92* for further diagnosis.

⇓ **If DTC U0109 is not set**

3. Verify the active grille air shutter actuator opens and closes the louvers at the front bumper when performing the Active Grille Air Shutter System test with a scan tool.

⇒ **If the louvers at the front bumper do not open and close and the test result is fail**

Refer to Circuit/System Testing.

⇓ **If the louvers at the front bumper open and close and the test result is pass**

4. Verify none of the following conditions are present:
   - Snow or ice packed in the front fascia which prevents the louvers from moving.
   - Debris or foreign objects which prevent the louvers from moving.

⇒ **If any of the conditions are present**

Clear any snow, ice or foreign objects from the front grille.

⇓ **If none of the conditions are present**

5. All OK

Circuit/System Testing

1. Vehicle OFF, and all vehicle systems OFF, disconnect the harness connector at the M96 Active Grille Air Shutter Actuator. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the ignition circuit terminal 3 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

4.1. Vehicle OFF.

4.2. Test for less than 2 Ω in the ignition circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse. Refer to *Power Mode Mismatch on page 11-857*.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

4.1. Vehicle OFF.

4.2. Test for infinite resistance between the ignition circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the M96 Active Grille Air Shutter Actuator.

⇓ **If the test lamp illuminates**

5. Connect a test lamp between the control circuit terminal 1 and the ignition circuit terminal 3.
6. Verify the test lamp turns On and Off when performing the Active Grille Air Shutter System test with a scan tool.

⇒ **If the test lamp is always Off**

6.1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, Vehicle ON.

6.2. Test for less than 1 V between the control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Vehicle OFF.

6.4. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K20 Engine Control Module.

⇒ **If the test lamp is always On**

6.1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

6.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K20 Engine Control Module.

⇓ **If the test lamp turns On and Off**

7. Vehicle OFF, connector the harness connector at the M96 Active Grille Air Shutter Actuator. Disconnect the harness connector at the K20 Engine Control Module, Vehicle in Service Mode.
8. Test for greater than 11 V between the control circuit terminal 8 and ground.

⇒ **If 11 V or less**

8.1. Vehicle OFF, disconnect the harness connector at the M96 Active Grille Air Shutter Actuator.

8.2. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the M96 Active Grille Air Shutter Actuator.

⇓ **If greater than 11 V**

9. Test or replace the M96 Active Grille Air Shutter Actuator.
10. Verify DTC U0284 is not set.

⇒ **If the DTC is set**

Replace the K20 Engine Control Module.

⇓ **If the DTC is not set**

11. All OK.

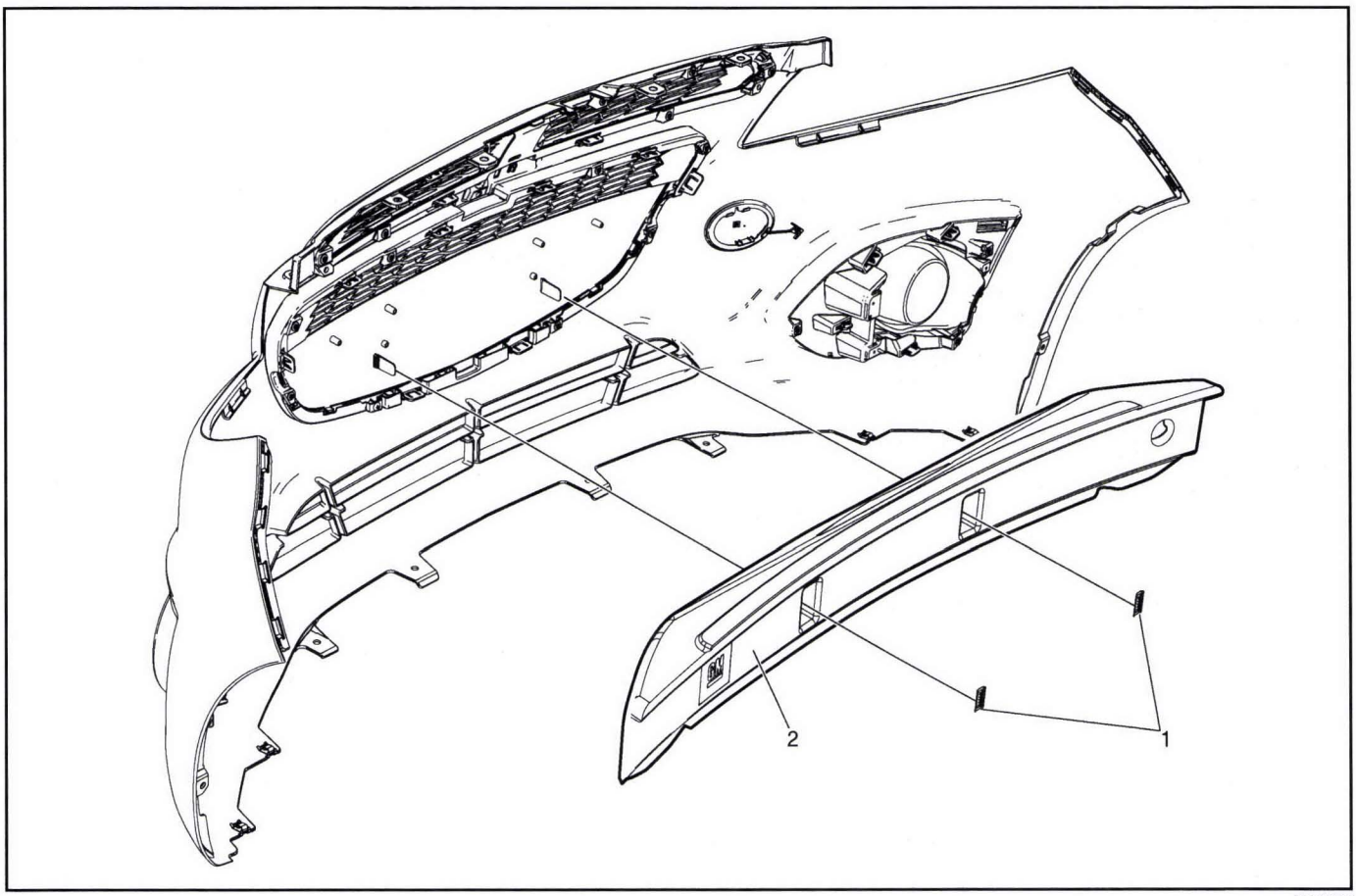
Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for engine control module replacement, programming and setup.

Repair Instructions

Front Bumper Fascia Energy Absorber Replacement



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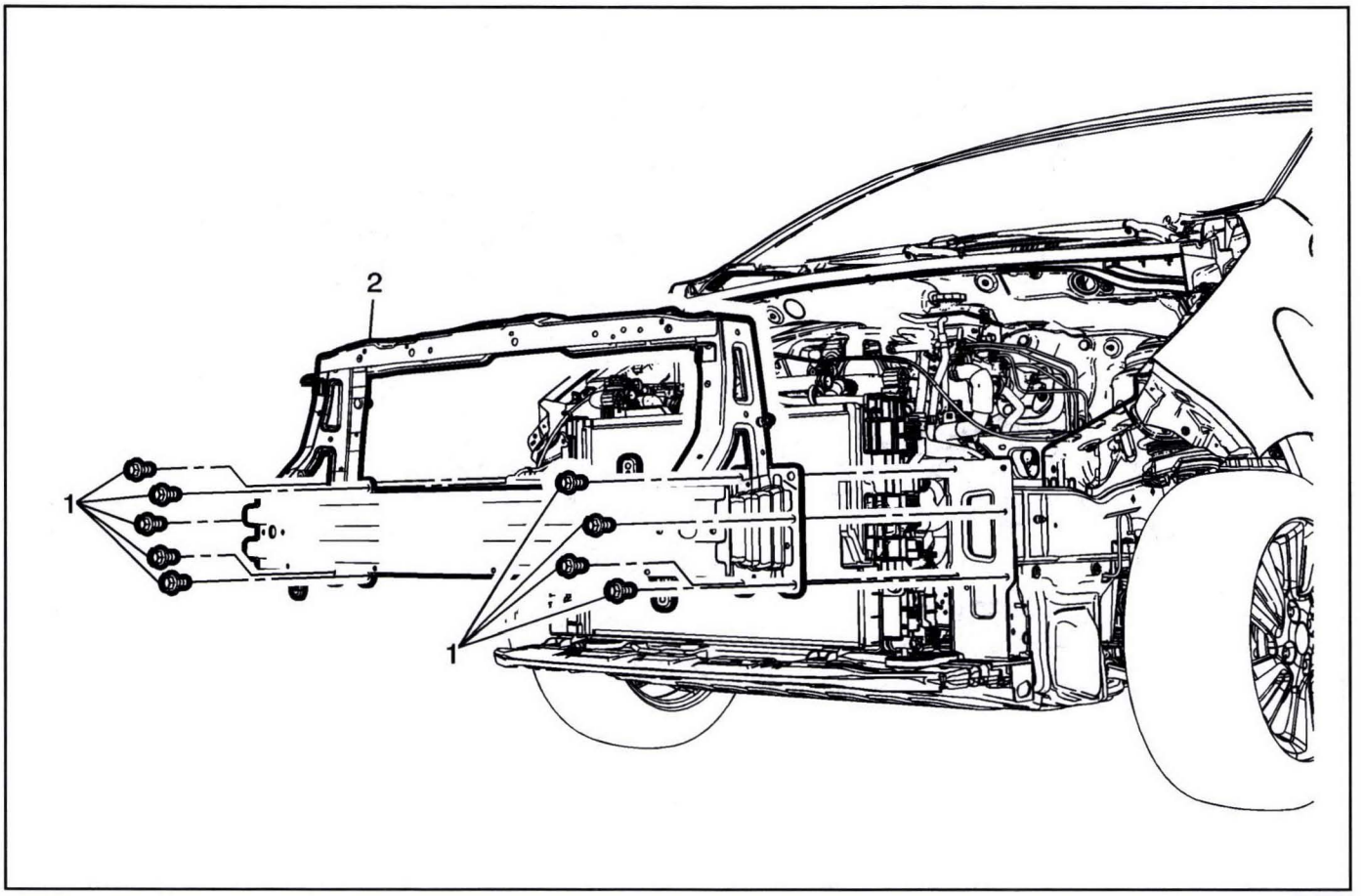
Front Bumper Fascia Energy Absorber Replacement

Callout	Component Name
Preliminary Procedure Remove the front bumper fascia. Refer to *Front Bumper Fascia Replacement on page 3-57*.	
1	Front Bumper Energy Absorber Clip
2	Front Bumper Energy Absorber

Front Bumper Impact Bar Replacement



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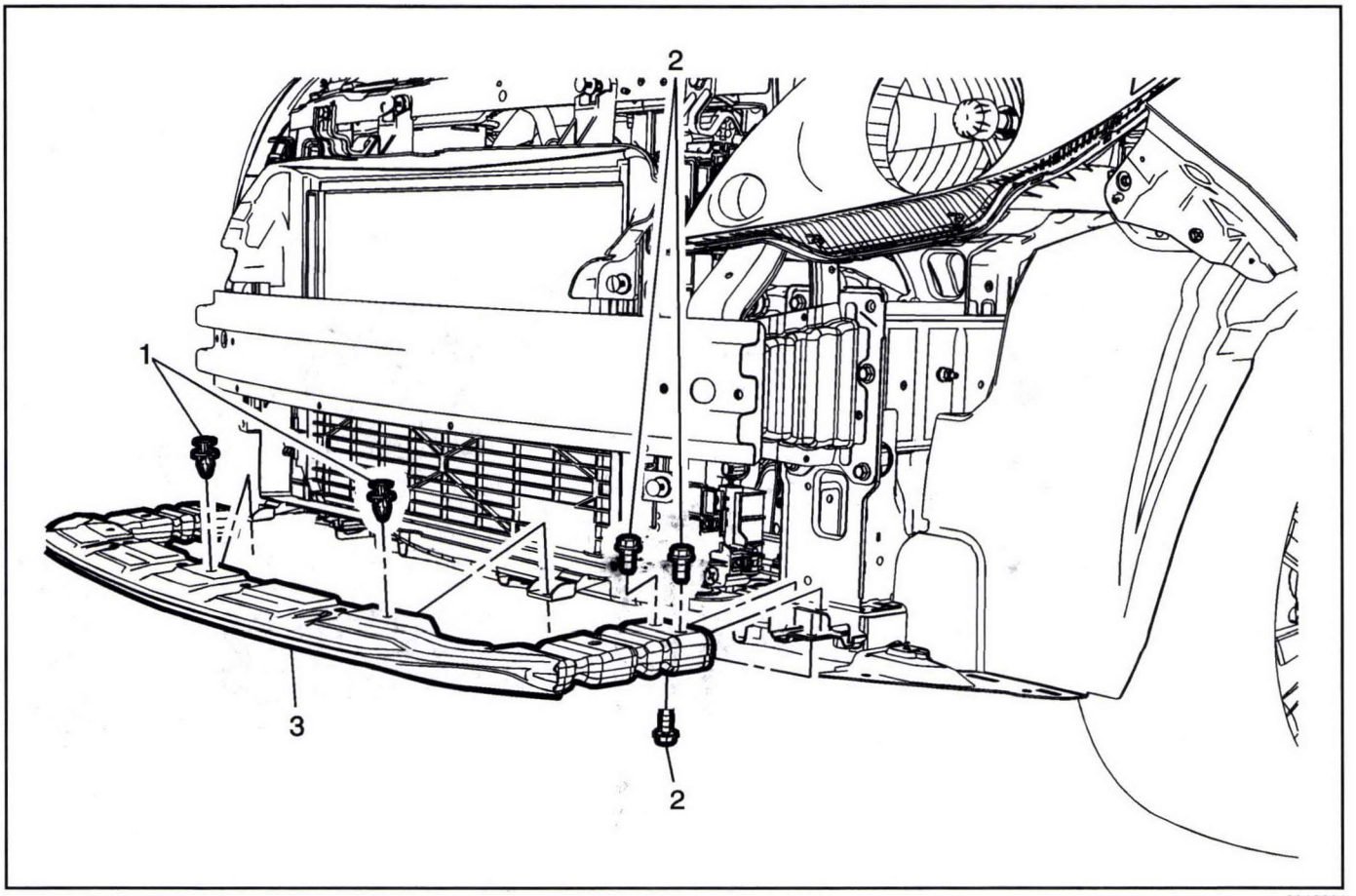
Front Bumper Impact Bar Replacement

Callout	Component Name
Preliminary Procedure 1. Remove the front bumper fascia. Refer to *Front Bumper Fascia Replacement on page 3-57*. 2. Remove the headlamp. Refer to *Headlamp Replacement on page 4-178*. 3. Remove the hood primary and secondary latch. Refer to *Hood Primary and Secondary Latch Replacement on page 3-33*. 4. Remove the radiator air lower baffle and deflector. Refer to *Radiator Air Lower Baffle and Deflector Replacement (Air Baffle Lower) on page 9-301*. 5. Remove the radiator air upper baffle and deflector. Refer to *Radiator Air Upper Baffle and Deflector Replacement (Air Baffle Upper) on page 9-302* or *Radiator Air Upper Baffle and Deflector Replacement (On Top of Radiator) on page 9-303* 6. Remove the radiator upper bracket. Refer to *Radiator Upper Bracket Replacement on page 9-289*. 7. Remove the horn. Refer to *Horn Replacement on page 4-62*.	
1	Front Bumper Impact Bar Bolt (Qty: 9) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 22 N•m (16 lb ft)
2	Front Bumper Impact Bar

Front Bumper Lower Impact Bar Replacement



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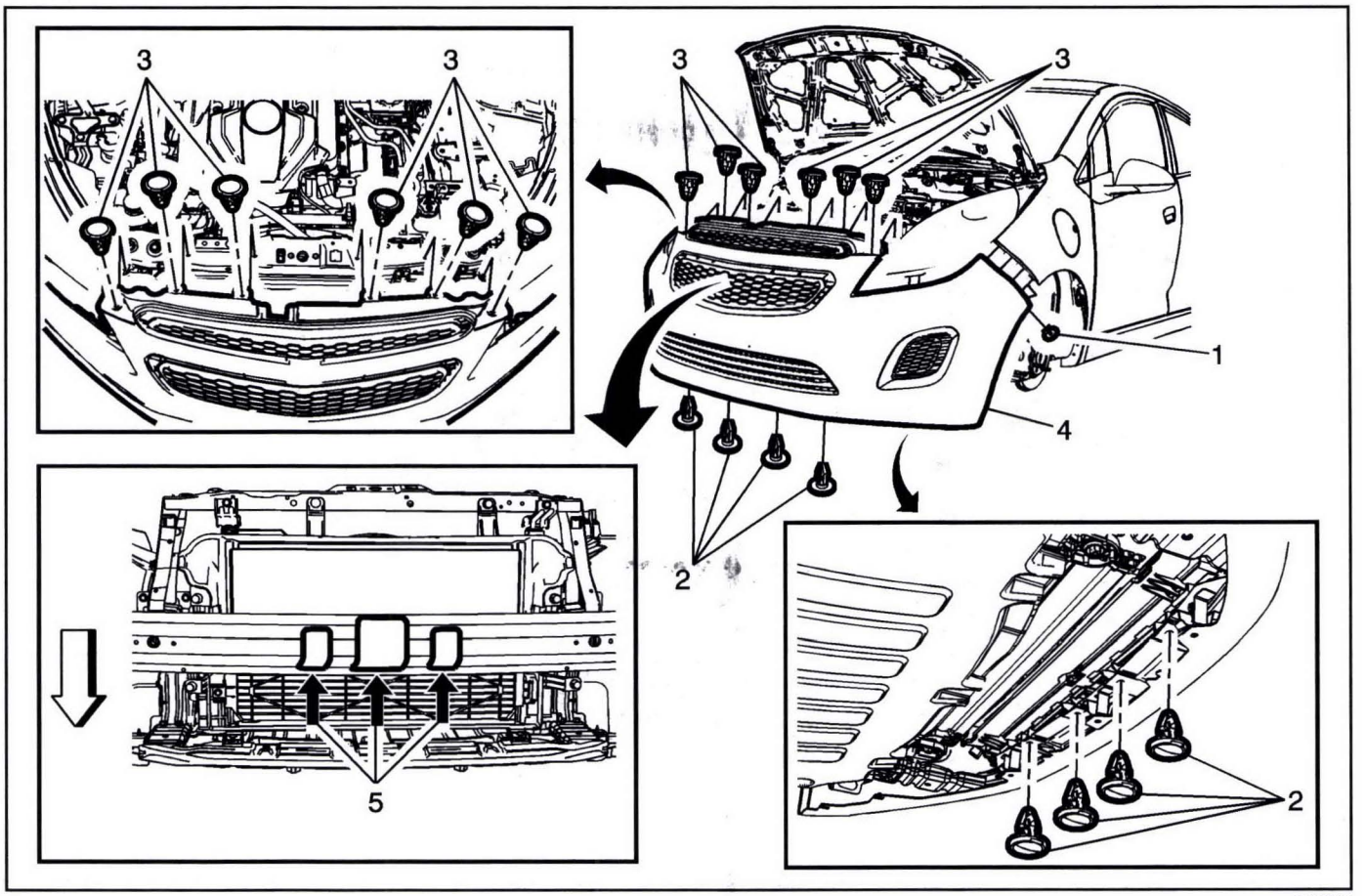
Front Bumper Lower Impact Bar Replacement

Callout	Component Name
Preliminary Procedure Remove the front bumper fascia. Refer to *Front Bumper Fascia Replacement on page 3-57*.	
1	Front Bumper Lower Impact Bar Push-In Retainers (Qty 2)
2	Front Bumper Lower Impact Bar Bolt (Qty :6) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 22 N•m (16 lb ft)
3	Front Bumper Lower Impact

Front Bumper Fascia Replacement



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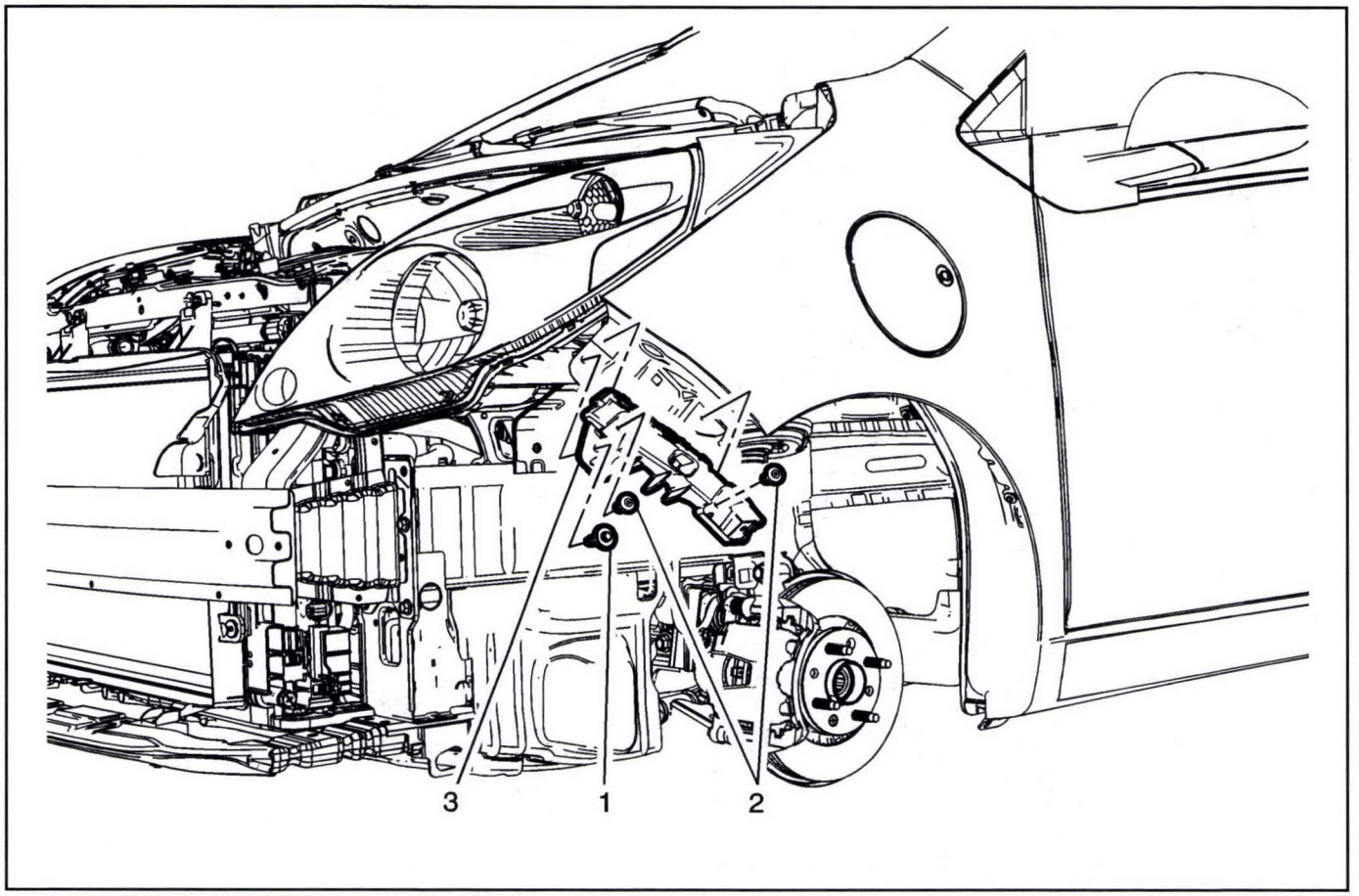
Front Bumper Fascia Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the front compartment front sight shield. Refer to *Front Compartment Front Sight Shield Replacement on page 3-39*. 2. Remove the front bumper fascia air deflector. Refer to *Front Bumper Fascia Air Deflector Replacement on page 3-62*. 3. Remove the front right hand and left hand wheelhouse liners. Refer to *Front Wheelhouse Liner Replacement - Right Side on page 3-138* or *Front Wheelhouse Liner Replacement - Left Side on page 3-139*.	
1	Front Bumper Fascia Bracket bolt (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Front Bumper Fascia Lower Push-In Retainers (Qty: 4)
3	Front Bumper Fascia Upper Push-In Retainers (Qty: 6)
4	Front Bumper Fascia **Procedure** 1. Carefully push a small nylon wedge between the fascia and the front fascia guide. Insert a small flat-bladed tool into the fascia slot and depress the snaps one at a time and pull on the fascia at the same time to gradually remove the fascia from the front fascia guide. 2. Disconnect any electrical connectors. 3. Transfer components as necessary.
5	Forward Lamp Harness **Procedure** Before installing the front bumper fascia make sure that the forward lamp harness is taped up at the location shown above (arrows). This will prevent any noise coming from the front bumper lower shutter.

Front Bumper Fascia Side Bracket Replacement

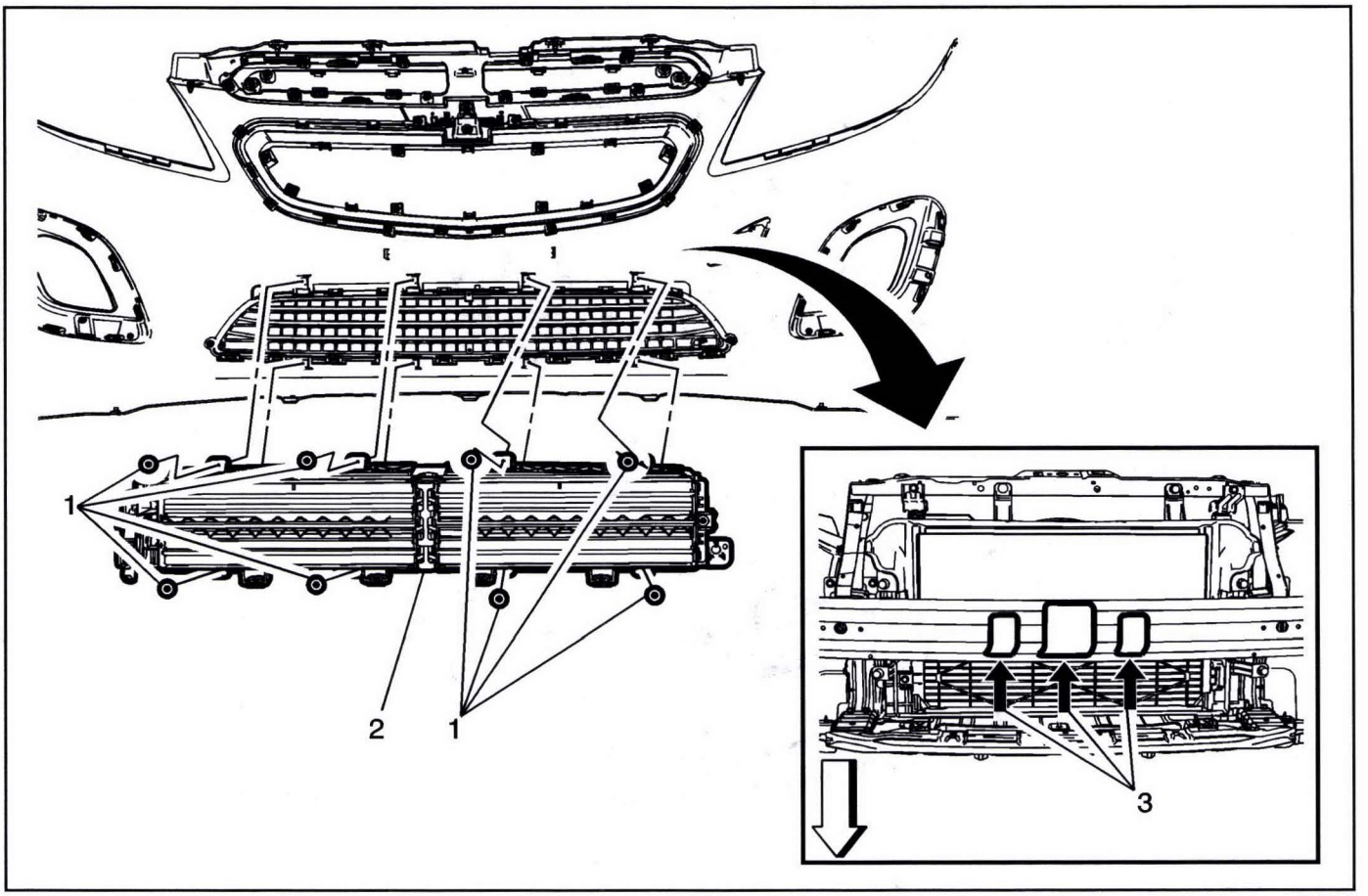


2916698

Front Bumper Fascia Side Bracket Replacement

Callout	Component Name
Warning: Refer to Eye Protection Warning on page 0-4.	
Preliminary Procedure Remove the front bumper fascia. Refer to *Front Bumper Fascia Replacement on page 3-57*.	
1	Headlamp Bolt **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Front Bumper Fascia Guide Rivet (Qty: 2)
3	Front Bumper Fascia Guide

Front Bumper Lower Shutter Replacement



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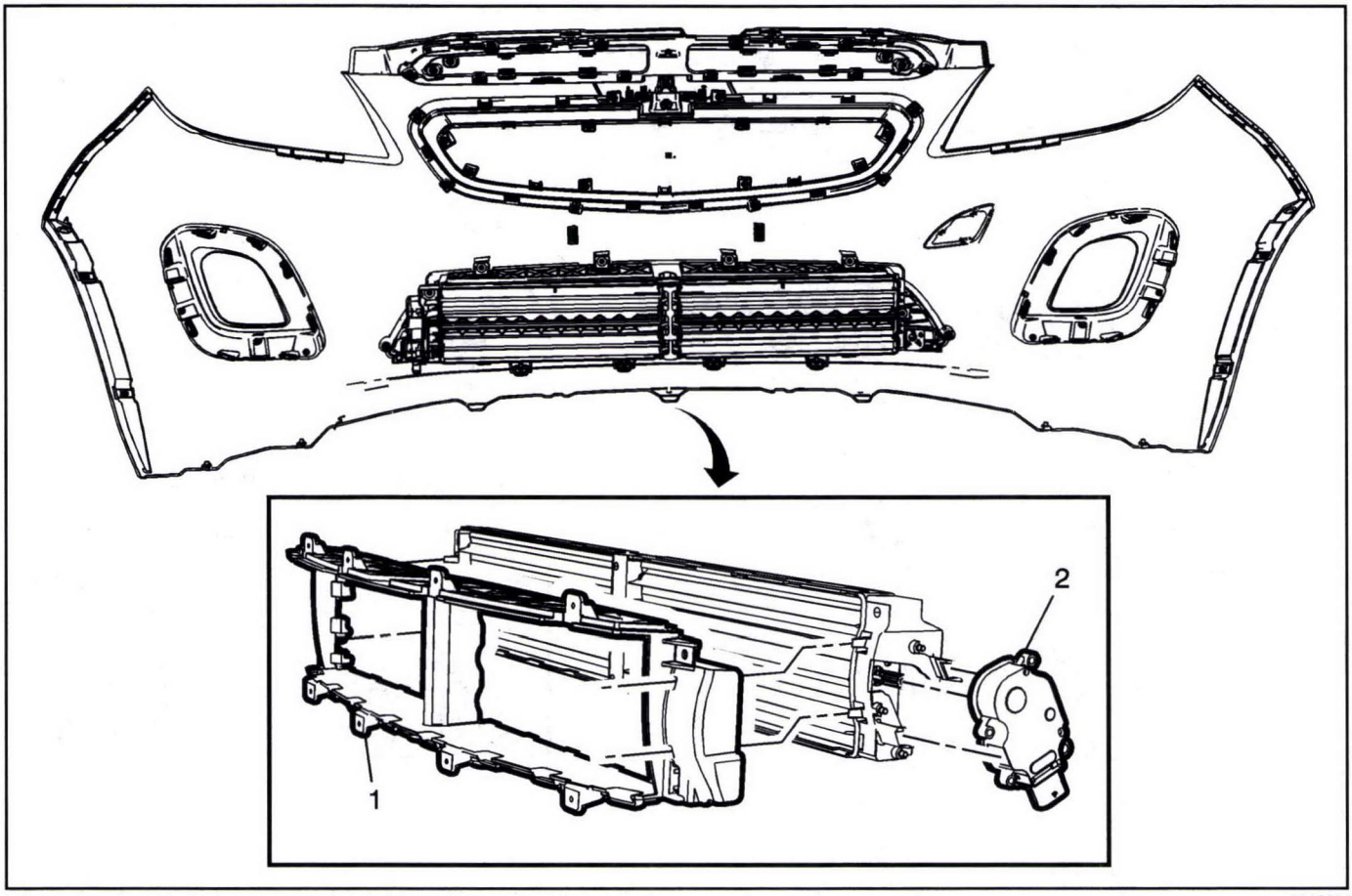
Front Bumper Lower Shutter Replacement

Callout	Component Name
Preliminary Procedures Remove the front bumper fascia. Refer to *Front Bumper Fascia Replacement on page 3-57*.	
1	Front Bumper Lower Shutter Bolts (Qty: 8) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Front Bumper Lower Shutter
3	Forward Lamp Harness **Procedure** Before installing the front bumper fascia make sure that the forward lamp harness is taped up at the location shown above (arrows). This will prevent any noise coming from the front bumper lower shutter.

Front Bumper Lower Shutter Actuator Replacement



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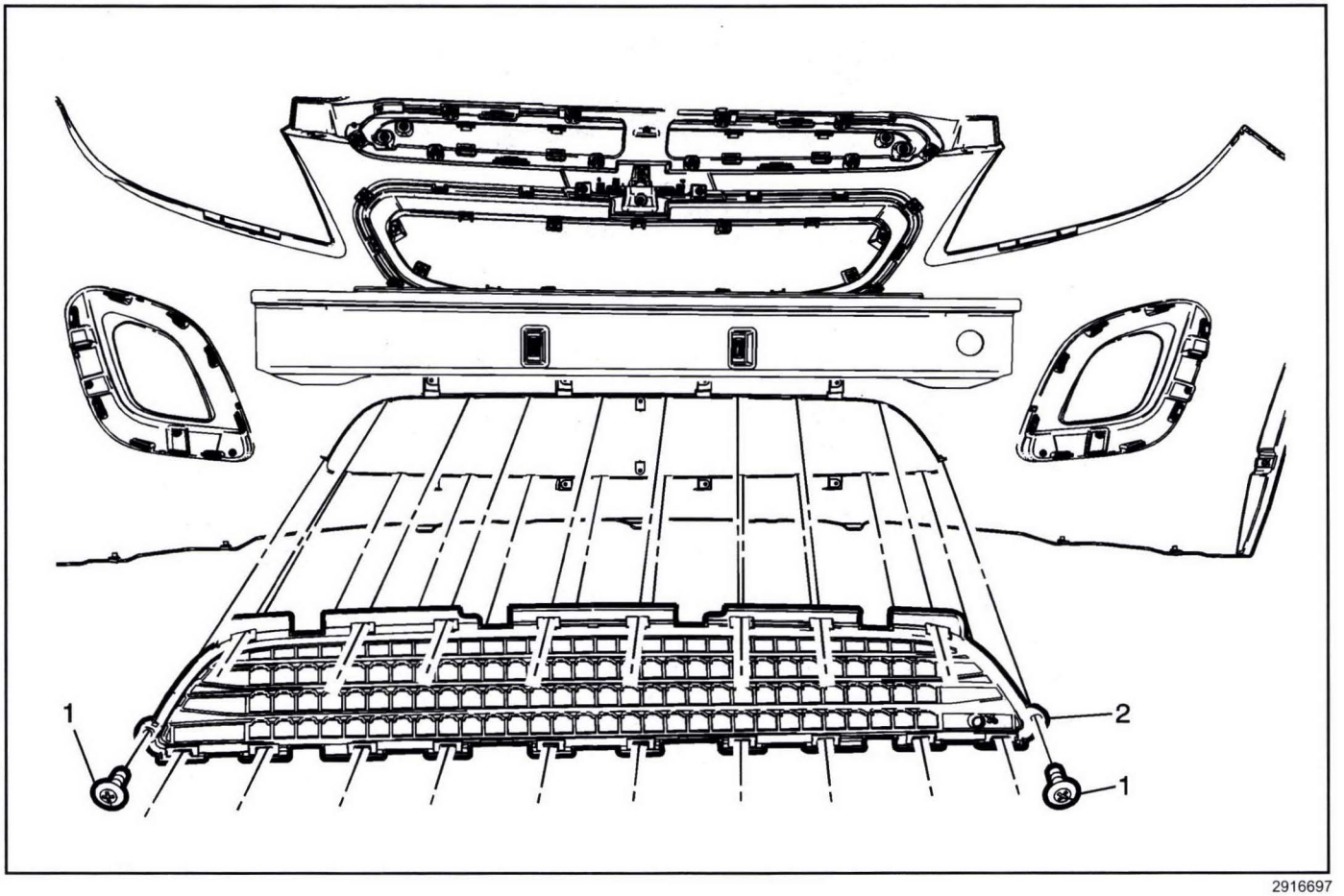
Front Bumper Lower Shutter Actuator Replacement

Callout	Component Name
Preliminary Procedure Remove the front bumper lower air shutter. Refer to *Front Bumper Lower Shutter Replacement on page 3-59*.	
1	Front Bumper Lower Shutter Bracket **Procedure** 1. Release the four retainer tabs.
2	Front Bumper Lower Shutter Actuator **Procedure** 1. Pressing outward from the center of the actuator, release the retainer tabs on both sides of the shutter actuator. 2. Slowly pull the shutter actuator from the alignment studs and retainer tabs. 3. To reinstall, position the shutter actuator to the alignment studs and retainer tabs and slowly press into place until the retainers are seated onto the actuator.

Front Bumper Fascia Opening Cover Replacement (Center)

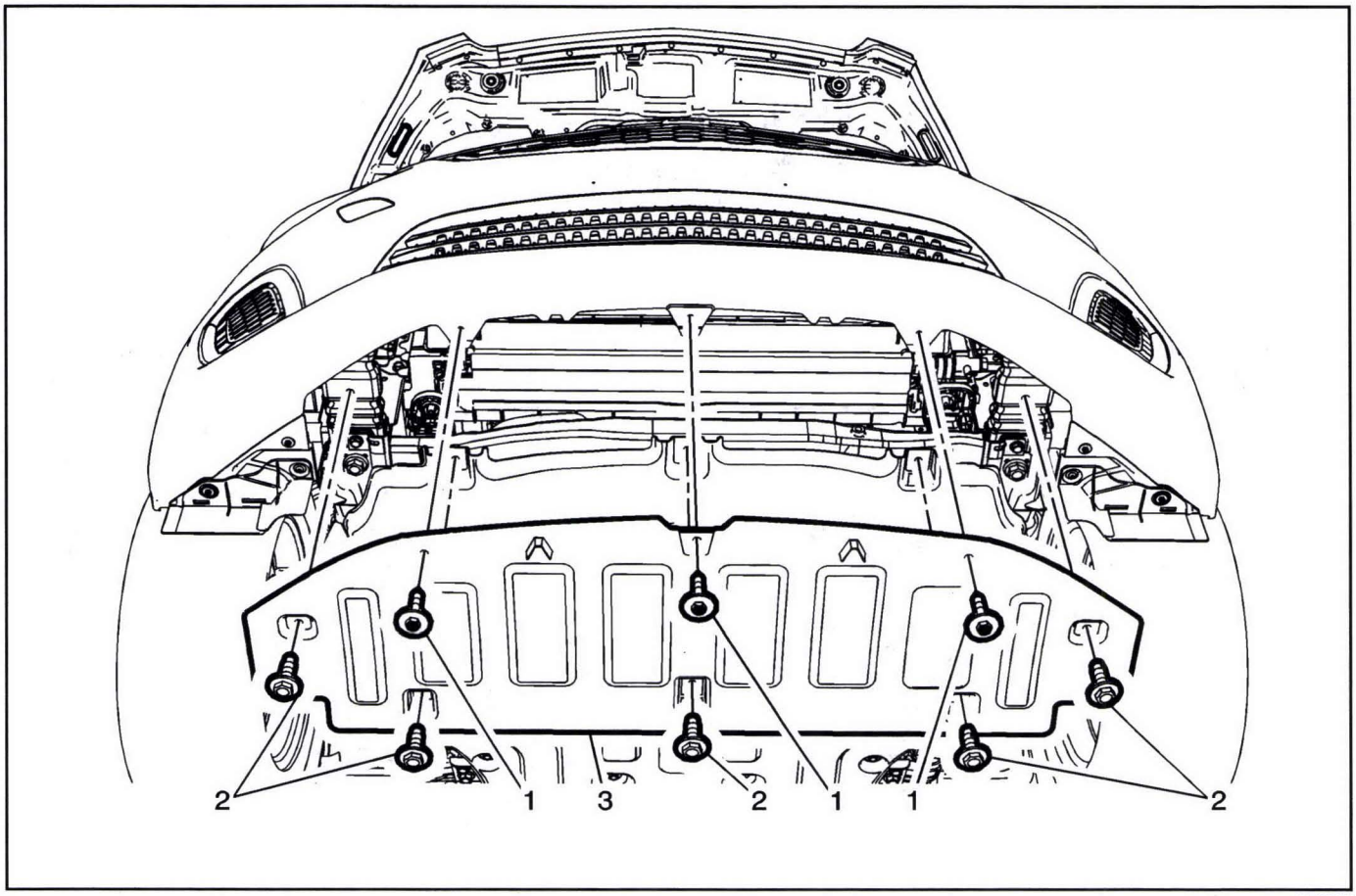


2916697

Front Bumper Fascia Opening Cover Replacement (Center)

Callout	Component Name
Preliminary Procedure Remove the front bumper fascia. Refer to *Front Bumper Fascia Replacement on page 3-57*.	
1	Front Bumper Fascia Opening Cover Bolt (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Front Bumper Fascia Opening Cover **Procedure** 1. Place the bumper fascia face down on a clean protected surface. 2. Using a suitable trim tool, release the twenty locking tabs while carefully pulling the front bumper fascia opening cover from the front bumper fascia.

Front Bumper Fascia Air Deflector Replacement

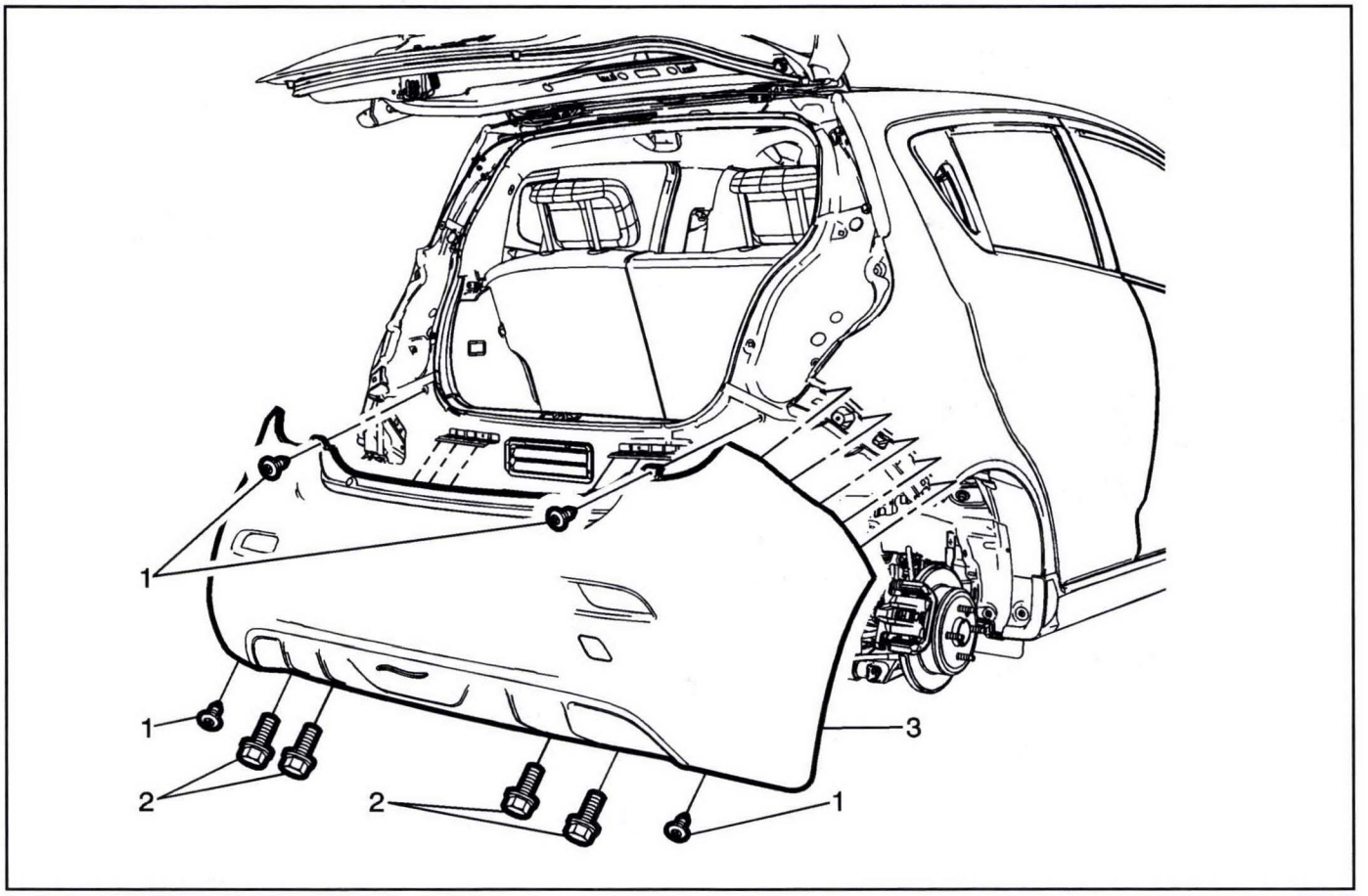


2916687

Front Bumper Fascia Air Deflector Replacement

Callout	Component Name
1	Front Bumper Fascia Opening Lower Cover Screw (Qty: 3) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Front Bumper Fascia Opening Lower Cover Bolt (Qty: 5) **Tighten** 9.5 N•m (84 lb in)
3	Front Bumper Fascia Opening Lower Cover

Rear Bumper Fascia Replacement

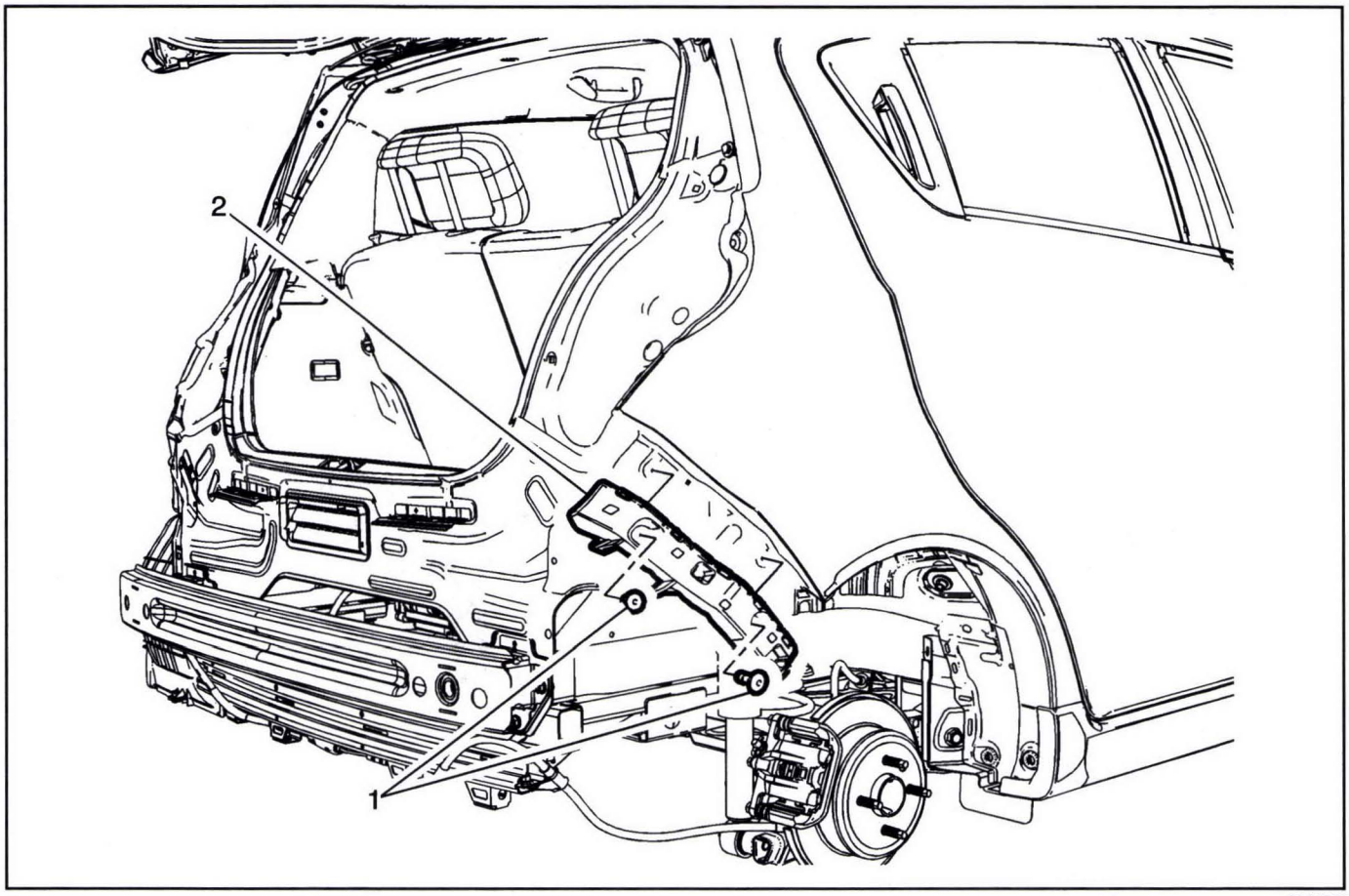


2916699

Rear Bumper Fascia Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the tail lamps. Refer to *Tail Lamp Replacement on page 4-192*. 2. Remove the rear wheelhouse liner. Refer to *Rear Wheelhouse Liner Replacement on page 3-140*.	
1	Rear Bumper Fascia Bolts (Qty: 4) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Underbody Rear Air Deflector Bolts (Qty: 4)
3	Rear Bumper Fascia **Procedure** 1. Carefully push a small nylon wedge between the fascia and the rear fascia guide. Insert a small flat-bladed tool into the fascia slot and depress the snaps one at a time and pull on the fascia at the same time to gradually remove the fascia from the rear fascia guide. 2. Disconnect any electrical connectors. 3. Transfer parts as needed.

Rear Bumper Fascia Bracket Replacement - Side

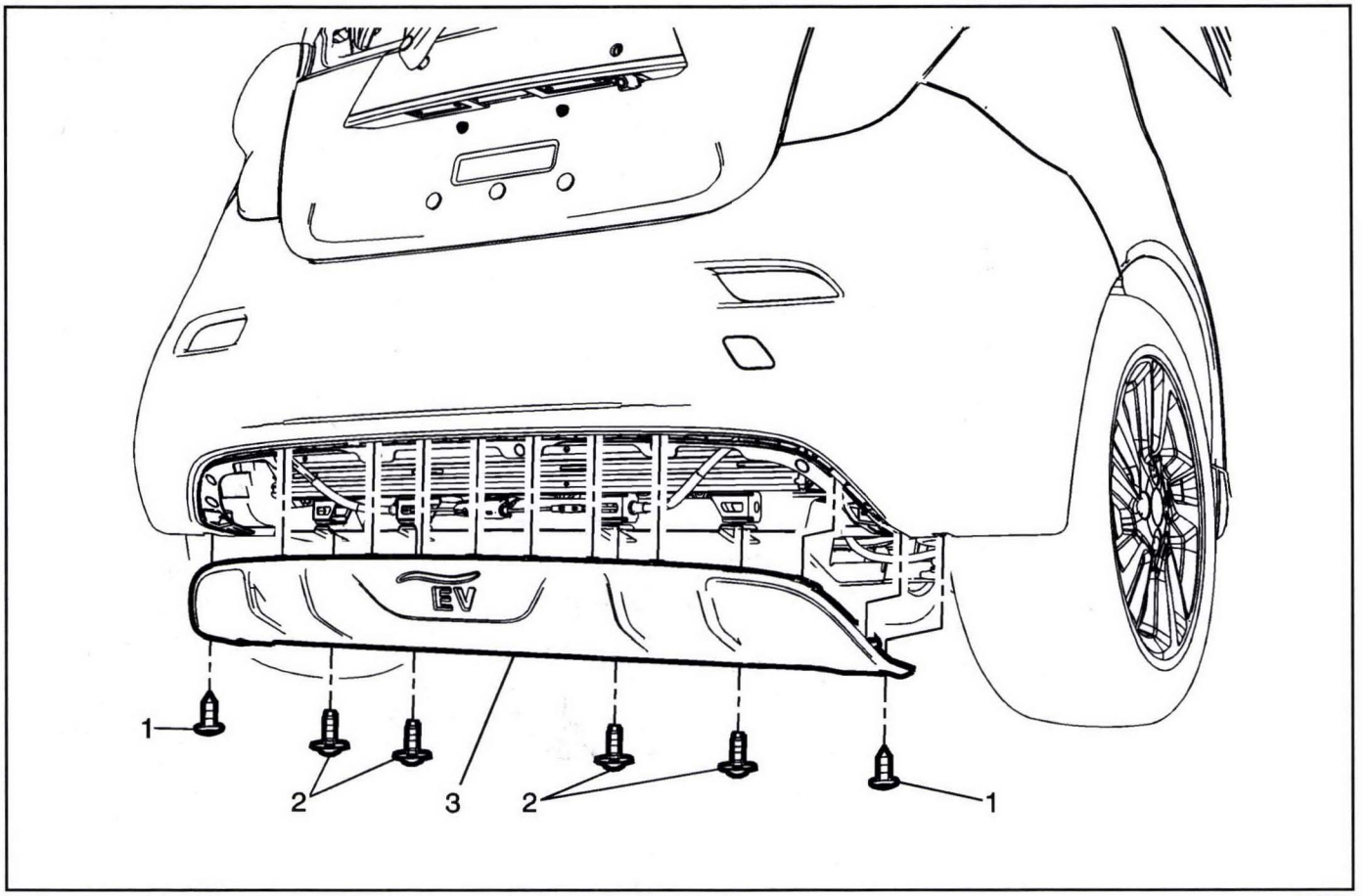


2916700

Rear Bumper Fascia Bracket Replacement - Side

Callout	Component Name
Warning: Refer to Eye Protection Warning on page 0-4. **Preliminary Procedure** Remove the rear bumper fascia. Refer to *Rear Bumper Fascia Replacement on page 3-63.*	
1	Rear Bumper Fascia Guide Rivet (Qty: 2)
2	Rear Bumper Fascia Guide

Rear Bumper Lower Fascia Replacement

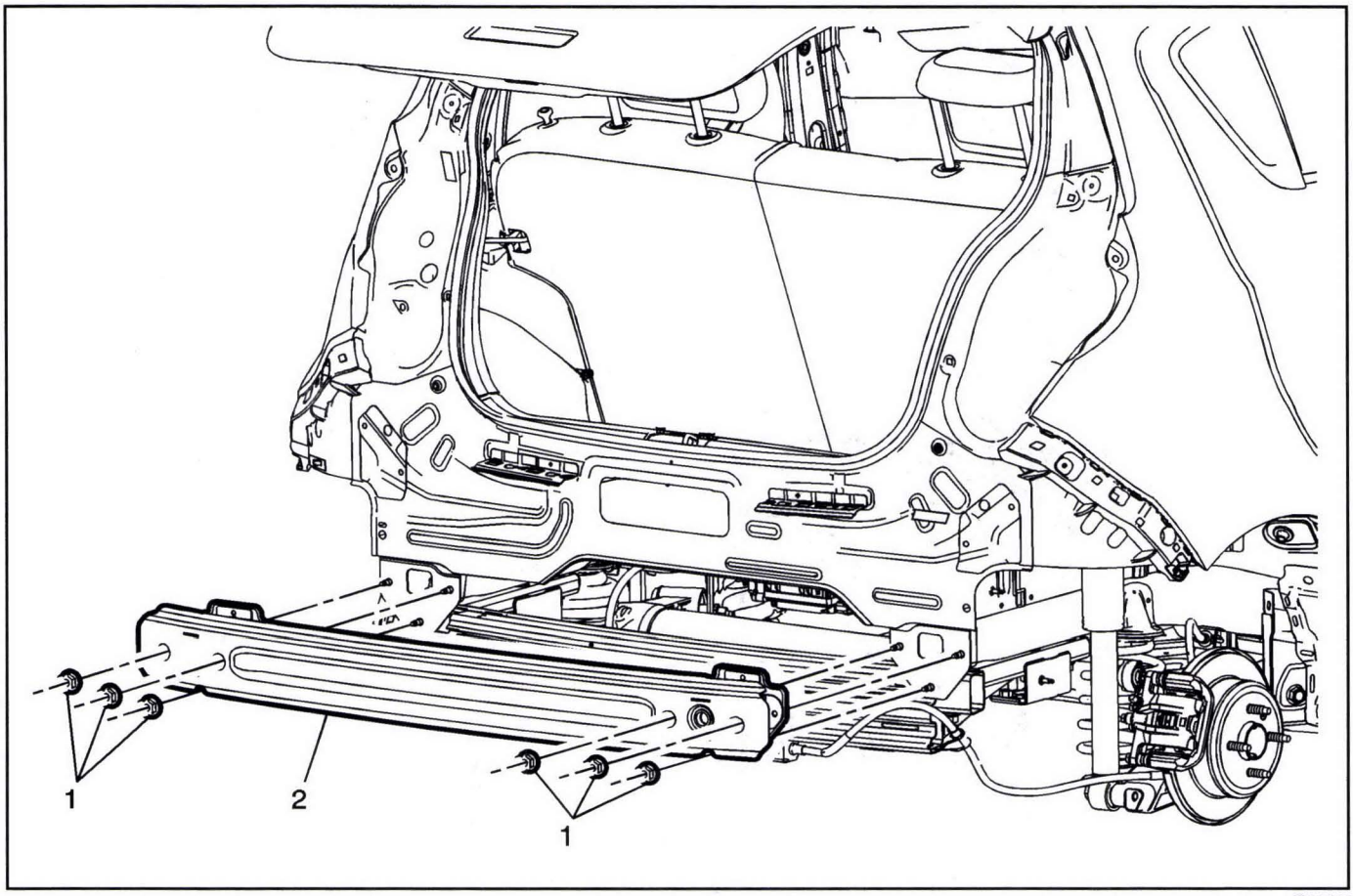


2916703

Rear Bumper Lower Fascia Replacement

Callout	Component Name
1	Rear Bumper Lower Fascia Screw (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Underbody Rear Air Deflector Bolts (Qty: 4)
3	Rear Bumper Lower Fascia **Procedure** 1. Carefully push a small nylon wedge between the upper fascia and the lower fascia. Insert a small flat-bladed tool into the fascia slot and depress the snaps one at a time and pull on the fascia at the same time to gradually remove the lower fascia from the upper fascias.

Rear Bumper Impact Bar Replacement



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Rear Bumper Impact Bar Replacement

Callout	Component Name
Preliminary Procedure Remove the rear bumper fascia. Refer to *Rear Bumper Fascia Replacement on page 3-63*.	
1	Rear Bumper Impact Bar Nut (Qty: 6) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 22 N•m (16 lb ft)
2	Rear Bumper Impact Bar

Description and Operation

Active Grille Air Shutter Description and Operation

The active grille air shutter actuator closes louvers at the front bumper to enhance vehicle aerodynamics in driving situations where cooling and A/C loads are relatively low and high levels of front end airflow are not required. If high levels of airflow are required the active grille air shutter actuator opens the louvers. The control signal from the engine control module, ignition and ground circuits enable the active grille air shutter actuator to operate. If the conditions for opening the louvers are reached the engine control module commands the active grille air shutter actuator to open the louvers.

The single active grille air shutter system consists of an individual motor operated mechanism hinged behind the vehicle front grille for controlling the amount of air entering the engine compartment. It includes three wires, ground, power and pulse width modulated signal to the actuator. The engine control module determines shutter state based on various vehicle conditions such as vehicle speed, coolant temperature, fan state, refrigerant system pressure, A/C compressor state and ambient temperature. The pulsed signal controlling the shutter mechanism will be able to control the shutter to close/open positions.

The actuator is powered by an ignition circuit that is active when the key is in the RUN position. The vehicle may have to be driven for up to 13 minutes at speeds greater than 41 kph (25 mph) before the shutter begins to move. If low ambient temperature is detected, the shutter will remain in the closed position.

Collision Repair

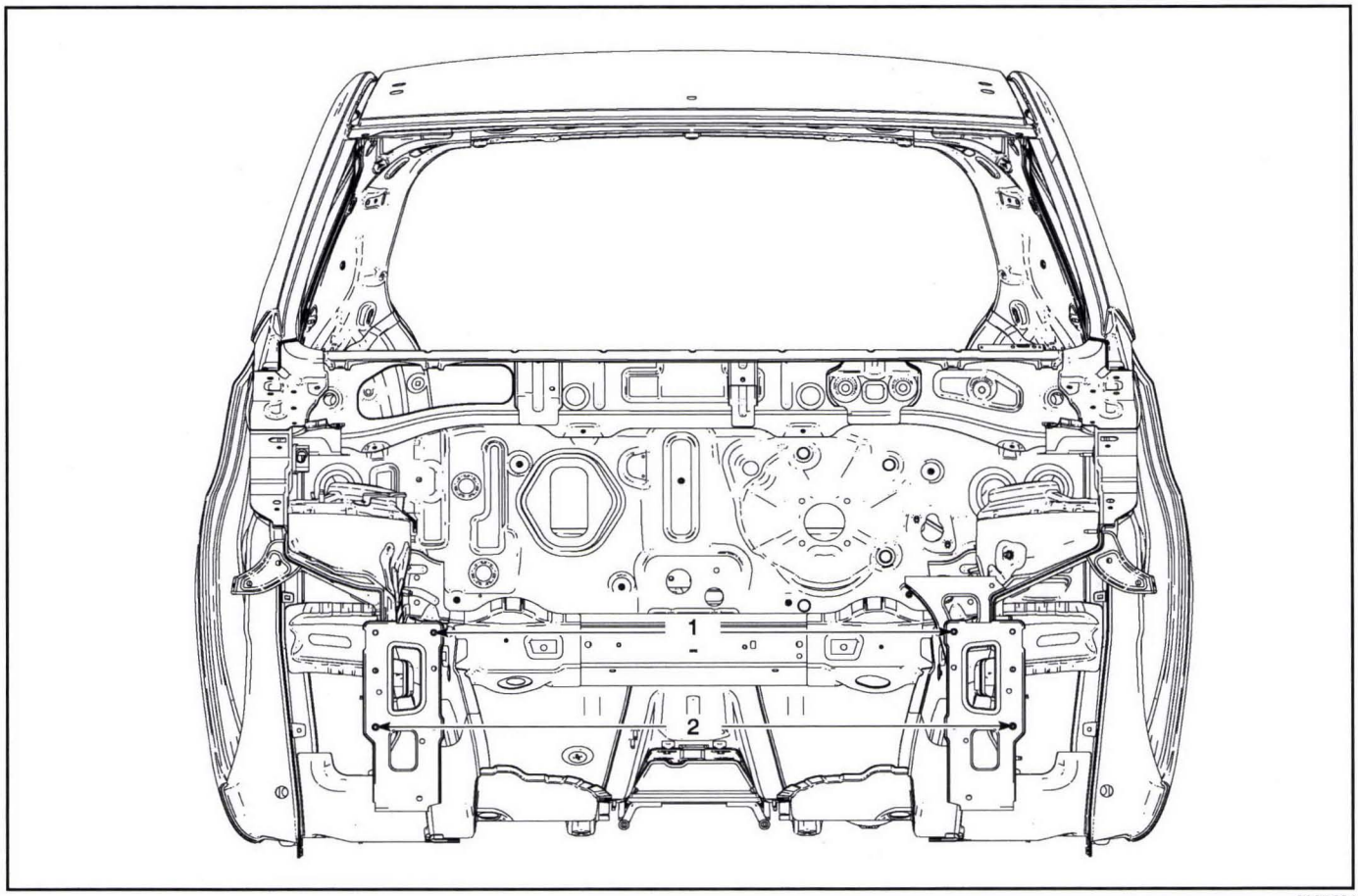
Specifications

Dimensions - Body

Point-to-point measurements are for reference only. All measurements are given in millimeters. Use these measurements for diagnosing and estimating. Point-to-point measurements are duplicated with tram bar pointers set at equal lengths. All die marks, holes, slots, and fasteners are measured to the center. All dimensions are symmetrical unless otherwise specified

Point-to-Point Measurements

Front End



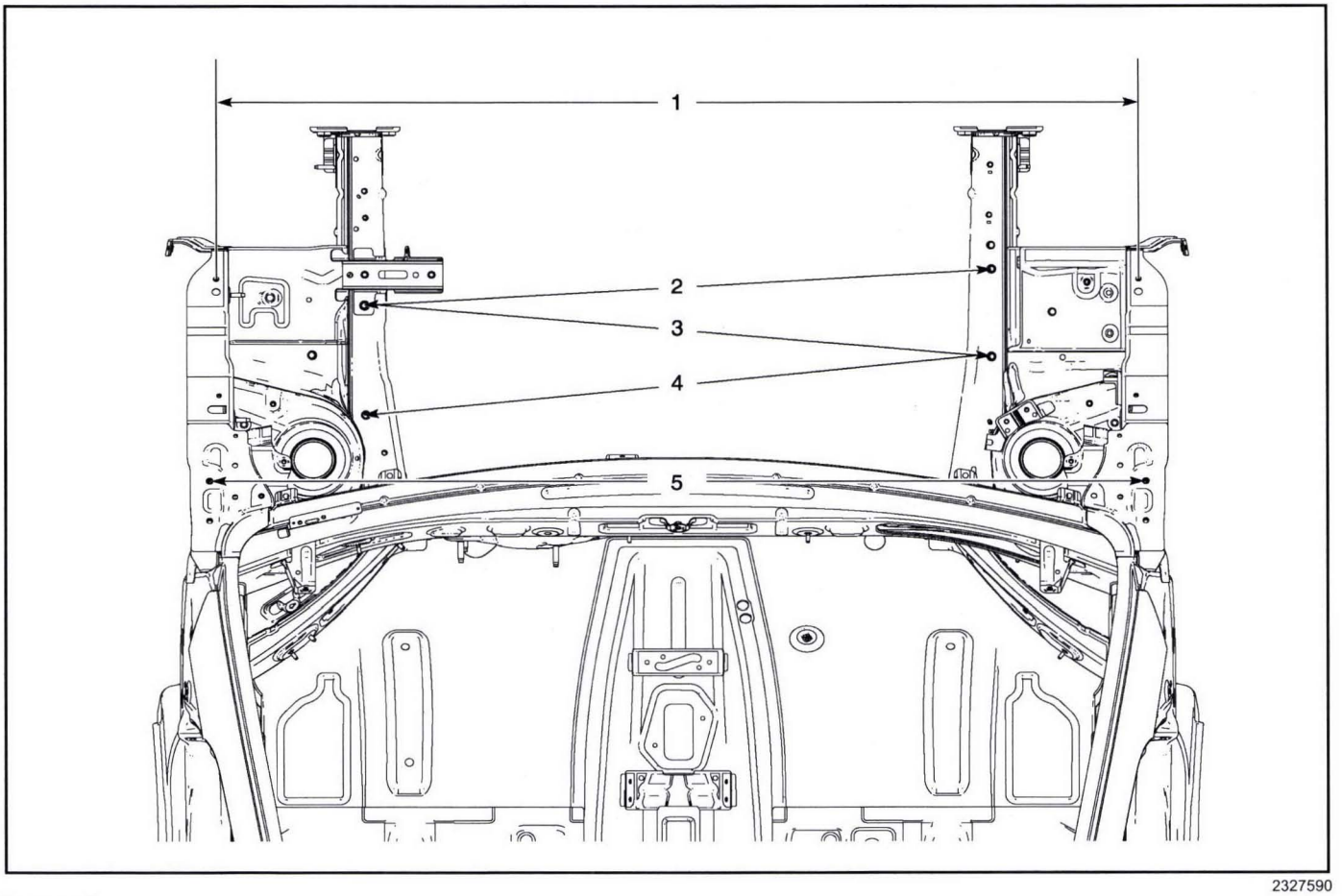
2327591

Legend

(1) 833 mm

(2) 1020 mm

Engine Compartment

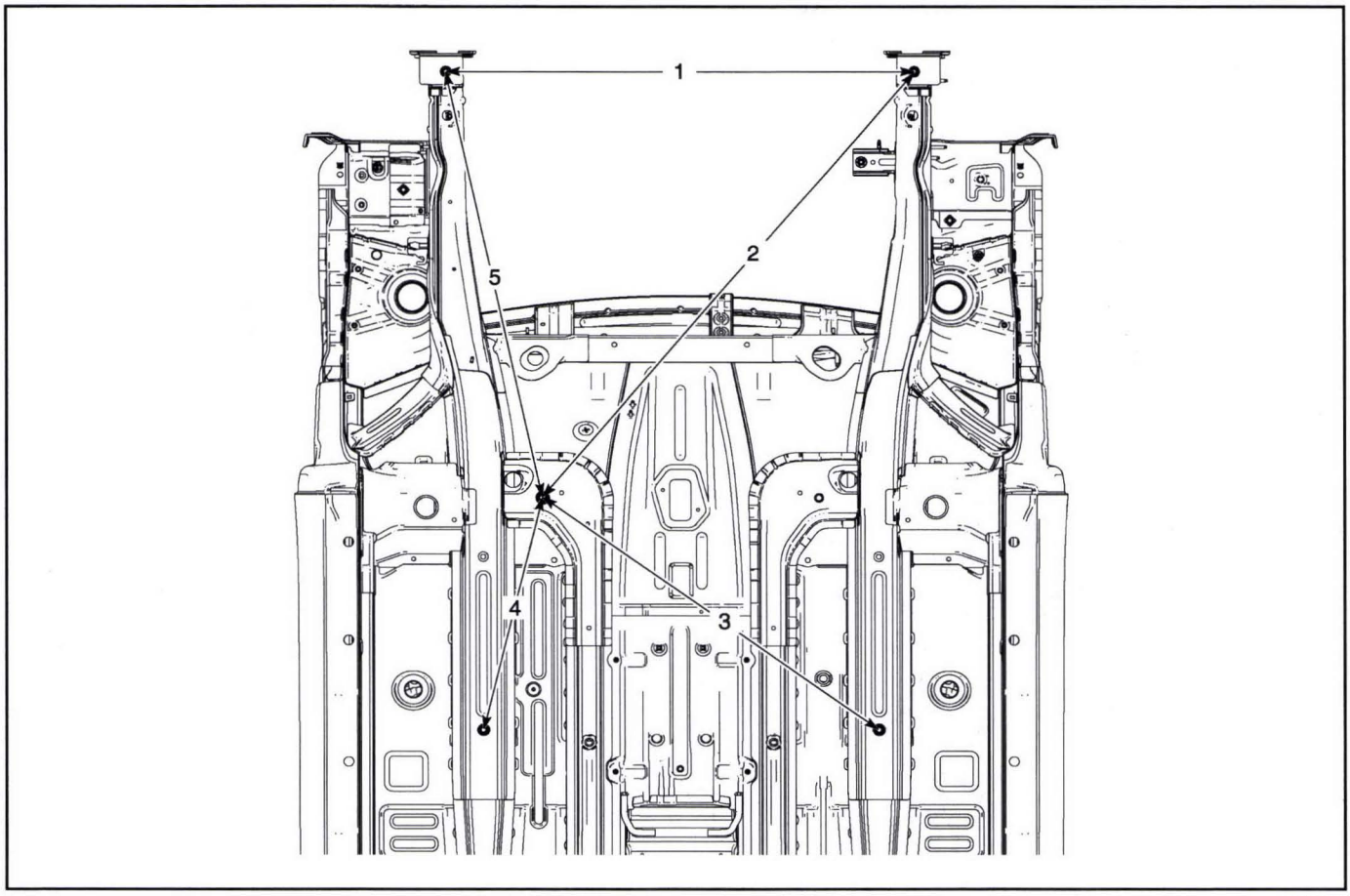


2327590

Legend

(1) 1334 mm
(2) 908 mm
(3) 909 mm
(4) 908 mm
(5) 1354 mm

Front End Lower

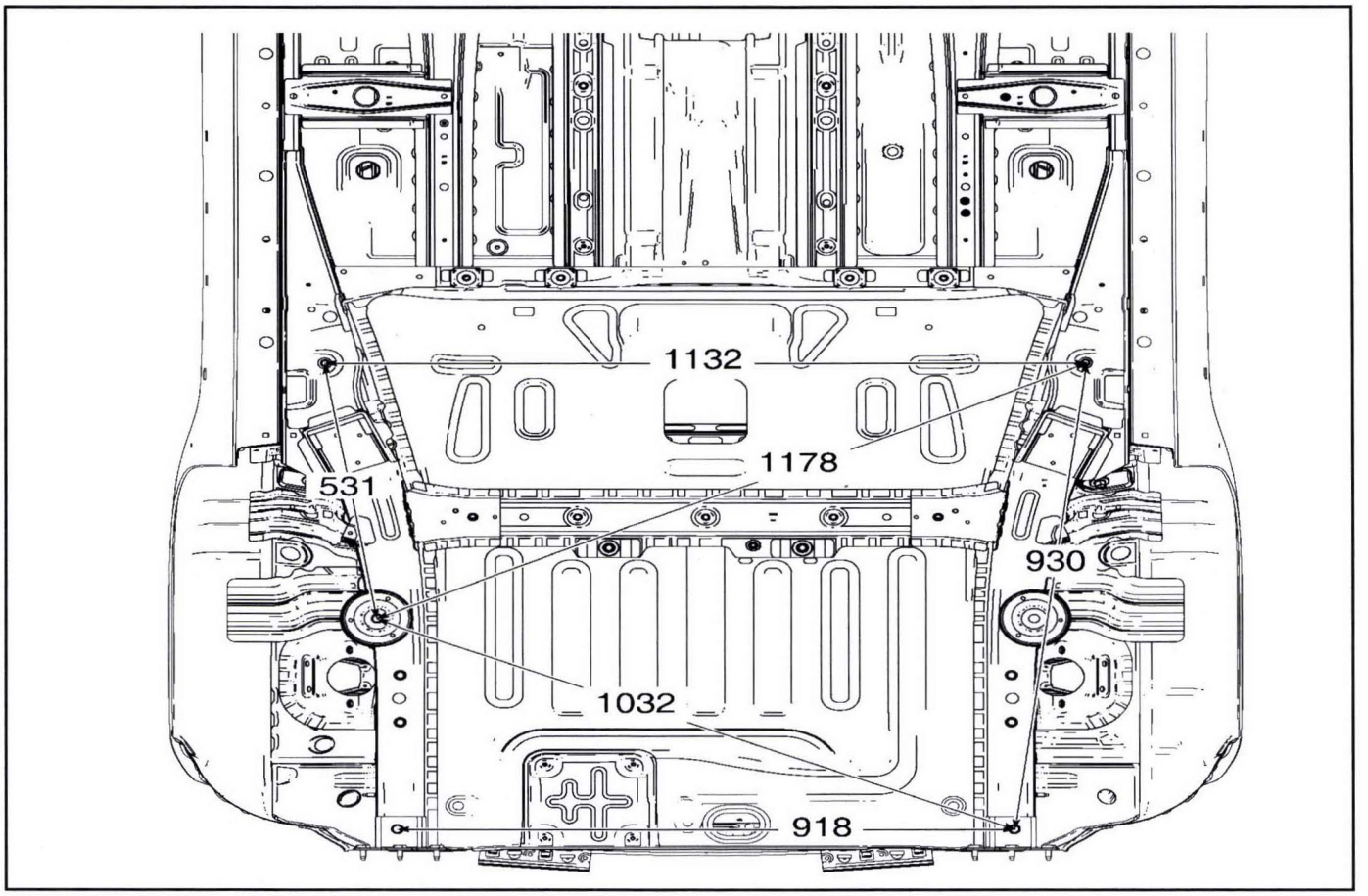


2327589

Legend

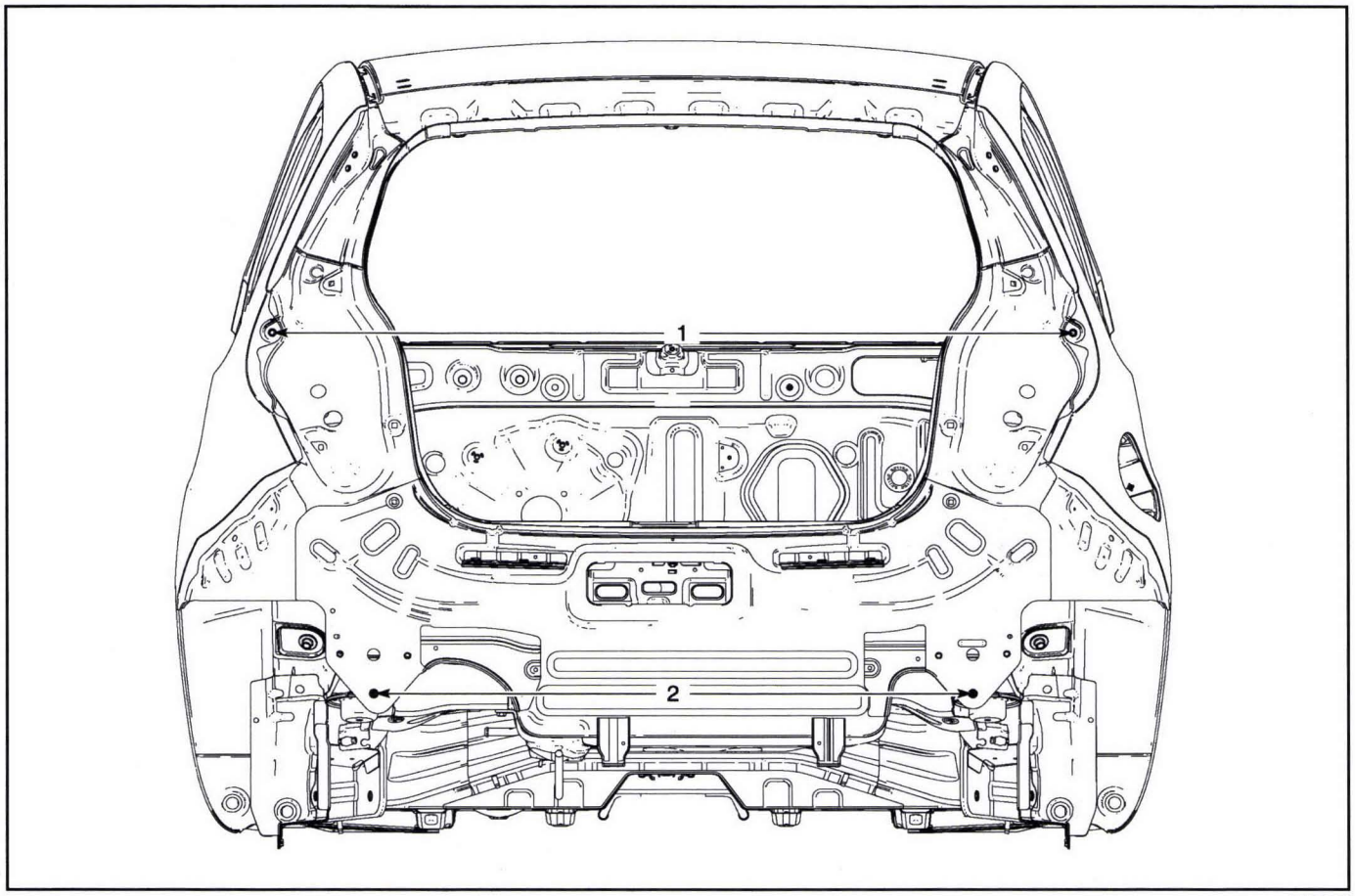
(1) 918 mm
(2) 1131 mm
(3) 812 mm
(4) 488 mm
(5) 884 mm

Rear End Lower



3608404

Rear End



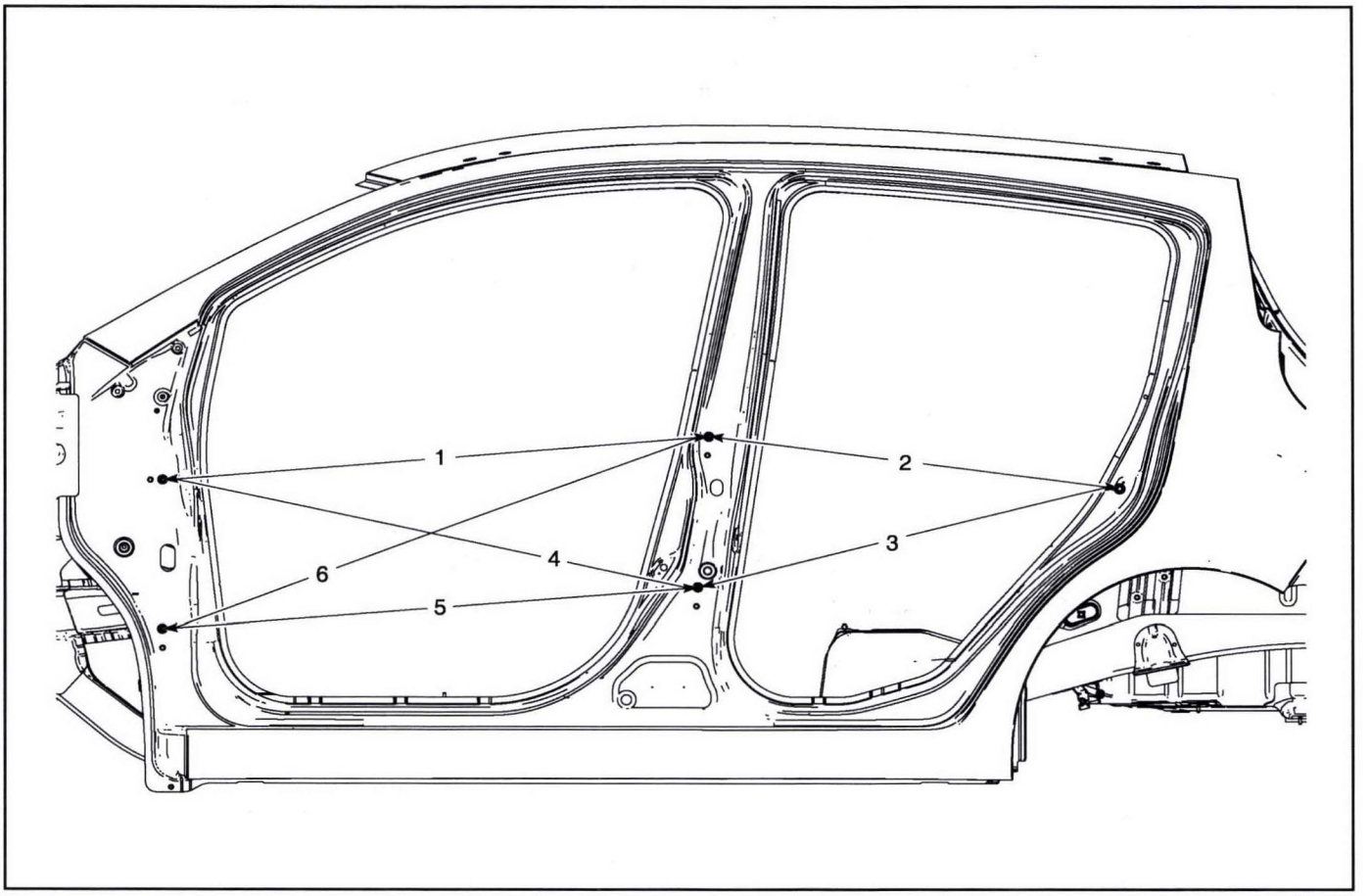
2327586

Legend

(1) 1284 mm

(2) 910 mm

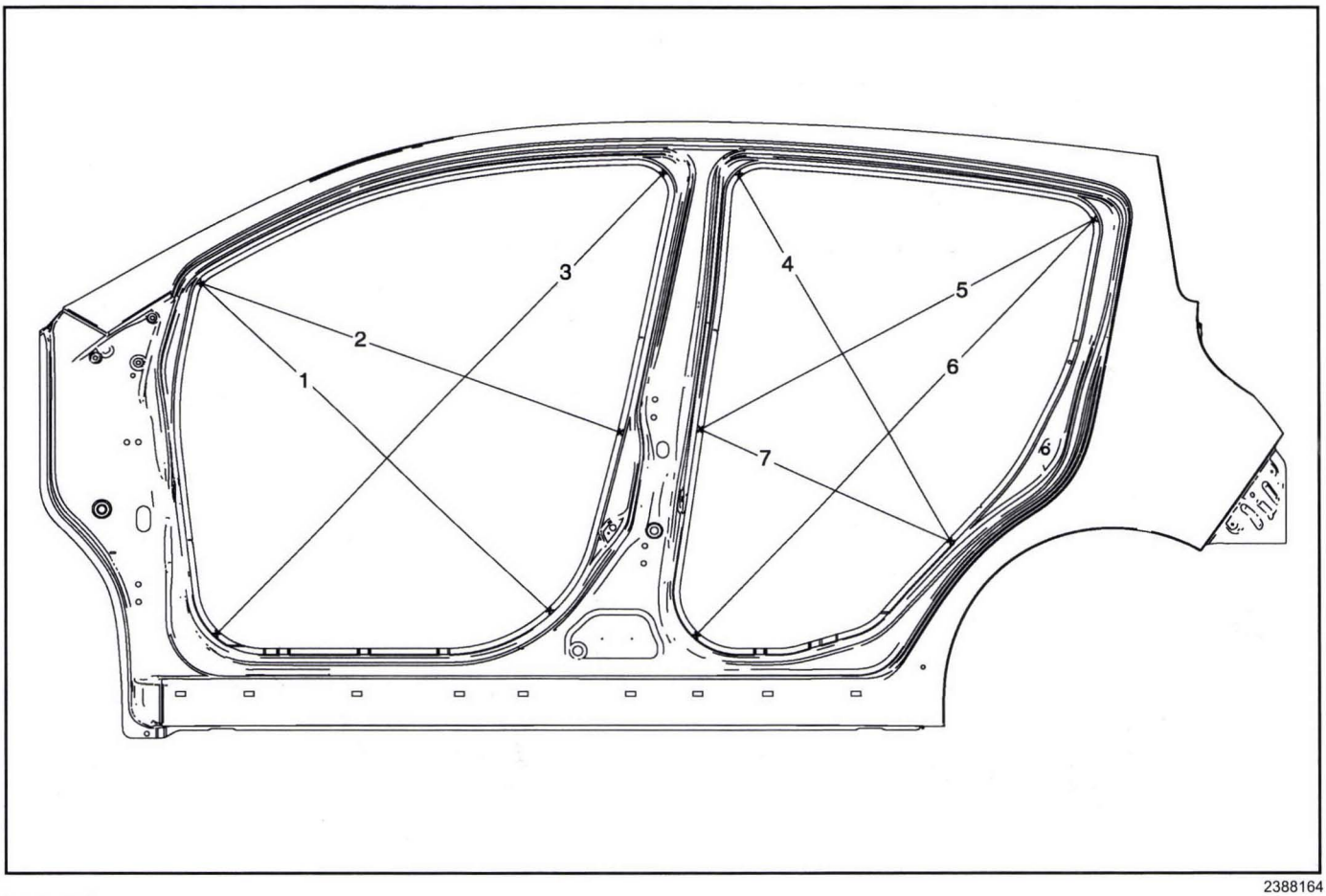
Side



2327584

Legend

(1)	1060 mm	(4)	1058 mm
(2)	805 mm	(5)	1039 mm
(3)	843 mm	(6)	1127 mm



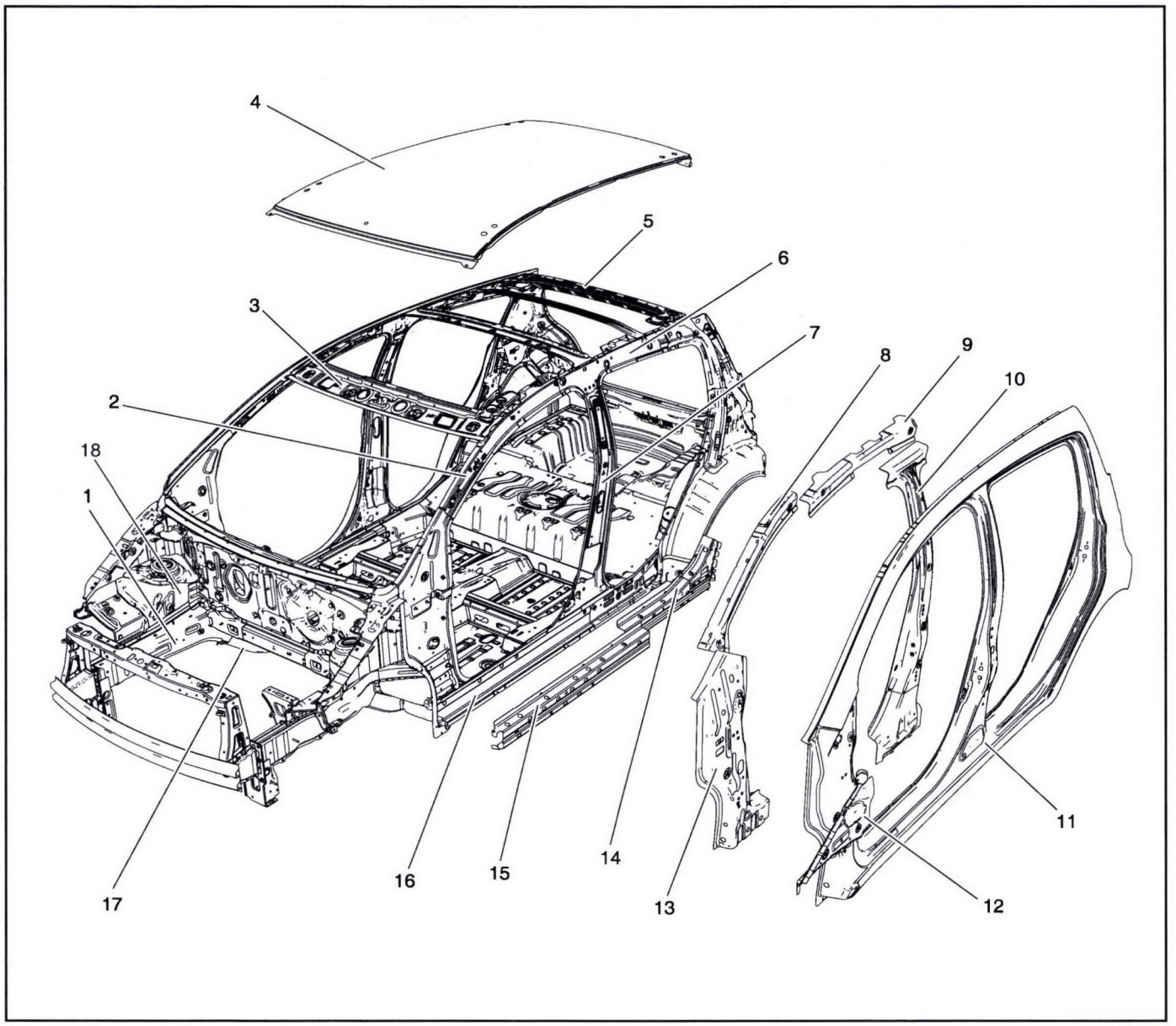
2388164

Legend

(1) 981 mm
(2) 916 mm
(3) 1338 mm
(4) 896 mm
(5) 927 mm
(6) 1199 mm
(7) 563 mm

Visual Identification

Structure Identification



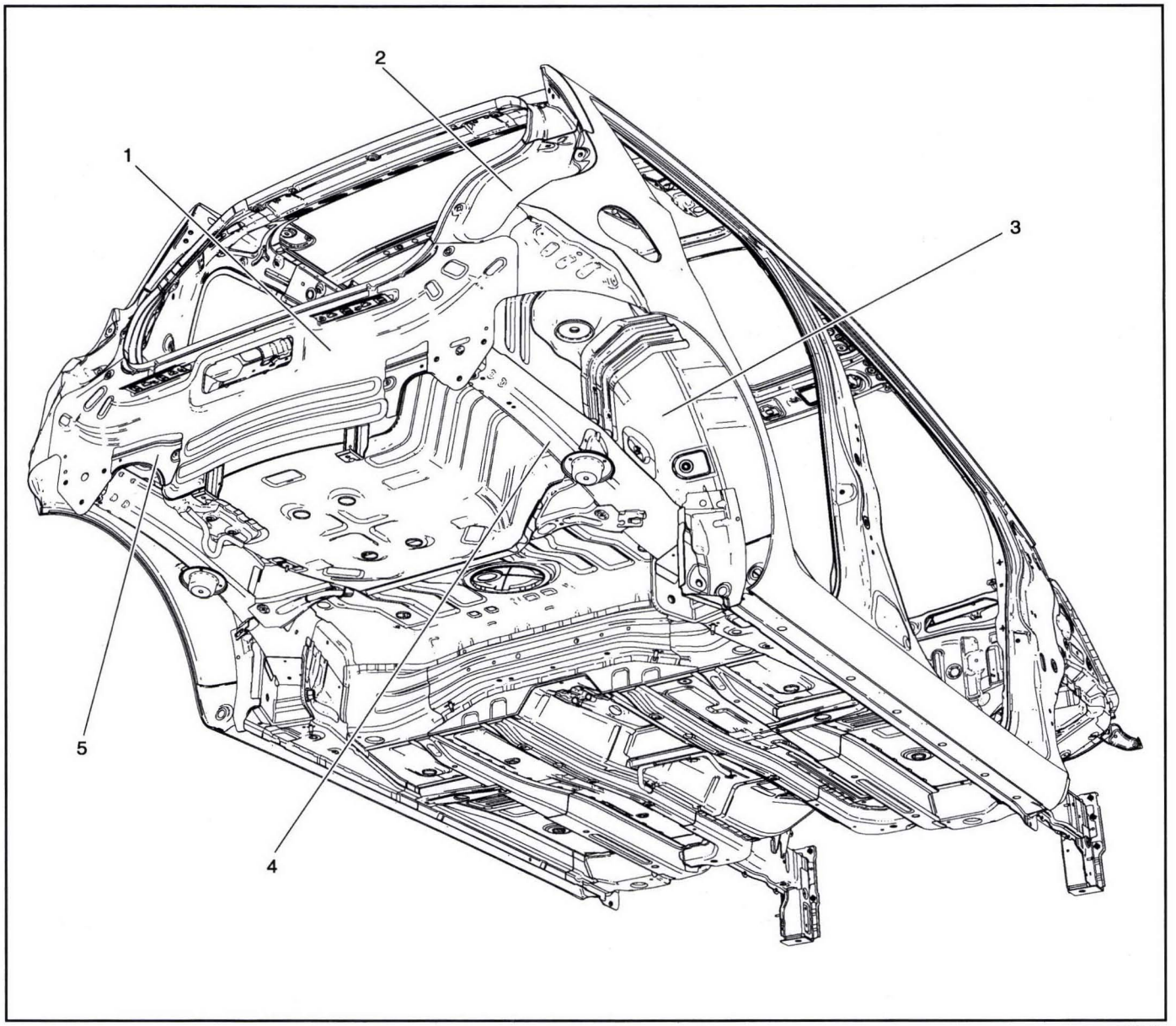
2355399

Front View

Number	Description	Material	Procedure
1	Front Compartment Side Rail (Front)	*High Strength Low Alloy Steel on page 3-116*	*Front Compartment Side Rail Bracket Replacement on page 3-80*
2	Roof Inner Front Side Rail	*Dual Phase Steel on page 3-115*	—
3	Roof Front Inner Panel	*Mild Steel on page 3-116*	*Roof Front Header Panel Replacement on page 3-90*
4	Roof Panel	*Mild Steel on page 3-116*	*Roof Outer Panel Replacement on page 3-88*
5	Roof Rear Inner Panel Assembly	*Mild Steel on page 3-116*	*Roof Rear Header Panel Replacement on page 3-91*
6	Roof Inner Rear Side Rail	*Dual Phase Steel on page 3-115*	—
7	Center Pillar Inner Panel	*Dual Phase Steel on page 3-115*	*Body Lock Pillar Inner Panel Replacement on page 3-98*

Front View (cont'd)

Number	Description	Material	Procedure
8	Roof Outer Front Side Rail	*Dual Phase Steel on page 3-115*	—
9	Roof Outer Rear Side Rail	*Dual Phase Steel on page 3-115*	—
10	Center Pillar Reinforcement	*High Strength Low Alloy Steel on page 3-116*	*Body Lock Pillar Outer Panel Reinforcement Replacement on page 3-97*
11	Body Side Outer Panel	*Mild Steel on page 3-116*	*Front Hinge Pillar Body Sectioning on page 3-85*
12	Front Compartment Upper Side Rail	*High Strength Low Alloy Steel on page 3-116*	*Front Compartment Upper Side Rail Replacement on page 3-83*
13	Hinge Pillar Outer Lower Reinforcement	*Dual Phase Steel on page 3-115*	*Body Hinge Pillar Lower Reinforcement Replacement on page 3-87*
14	Rocker Outer Panel Center Pillar Reinforcement Assembly	*Dual Phase Steel on page 3-115*	*Body Side Outer Panel Reinforcement Replacement on page 3-102*
15	Rocker Front Outer Panel Reinforcement	*Ultra High Strength Dual Phase Steel on page 3-116*	*Body Side Outer Panel Reinforcement Replacement on page 3-102*
16	Rocker Inner Panel	*Dual Phase Steel on page 3-115*	—
17	Floor Panel #2 Cross Bar	*Ultra High Strength Dual Phase Steel on page 3-116*	—
18	Front Wheelhouse Rear Panel	*High Strength Low Alloy Steel on page 3-116*	*Front Wheelhouse Panel Replacement on page 3-82*



2355401

Rear View

Number	Description	Material	Procedure
1	Rear End Lower Panel	*High Strength Low Alloy Steel on page 3-116*	*Rear End Panel Replacement on page 3-112*
2	Body Tail Lamp Fill Panel	*Mild Steel on page 3-116*	*Tail Lamp Pocket Replacement on page 3-114*
3	Rear Wheelhouse Inner Panel	*High Strength Low Alloy Steel on page 3-116*	*Quarter Inner Panel Replacement on page 3-108*
4	Underbody Rear Side Rear Rail	*High Strength Low Alloy Steel on page 3-116*	*Underbody Rear Side Rail Replacement on page 3-111*
5	Rear End Lower Panel Reinforcement	*High Strength Low Alloy Steel on page 3-116*	*Rear End Panel Replacement on page 3-112*

Repair Instructions

Drivetrain and Front Suspension Frame Front Support Replacement

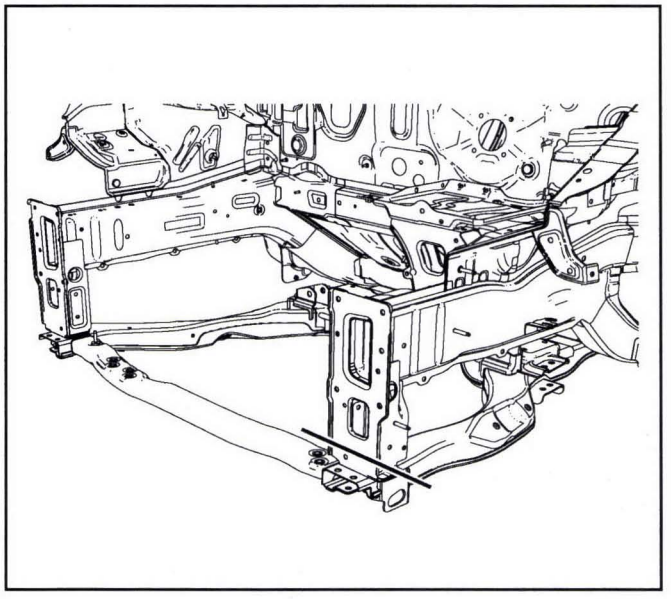
Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3

Warning: Refer to Collision Sectioning Warning on page 0-4

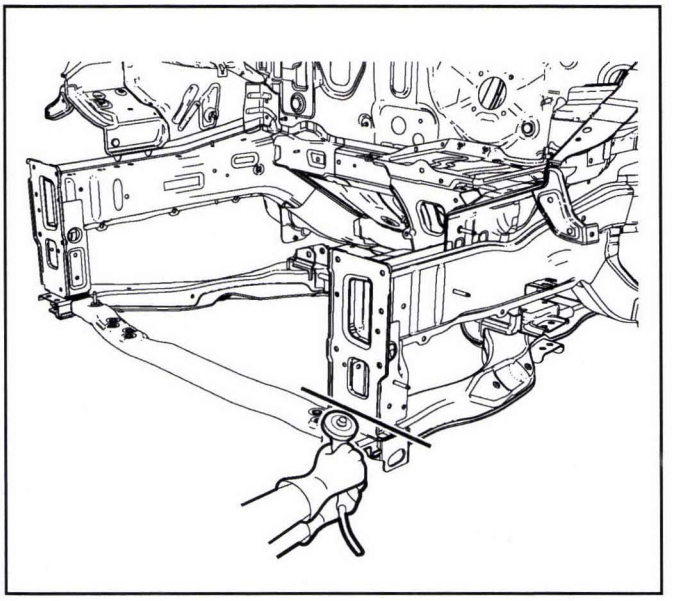
Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5

1. Disable the SIR System. Refer to *SIR Disabling and Enabling on page 12-151*
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*



2355467

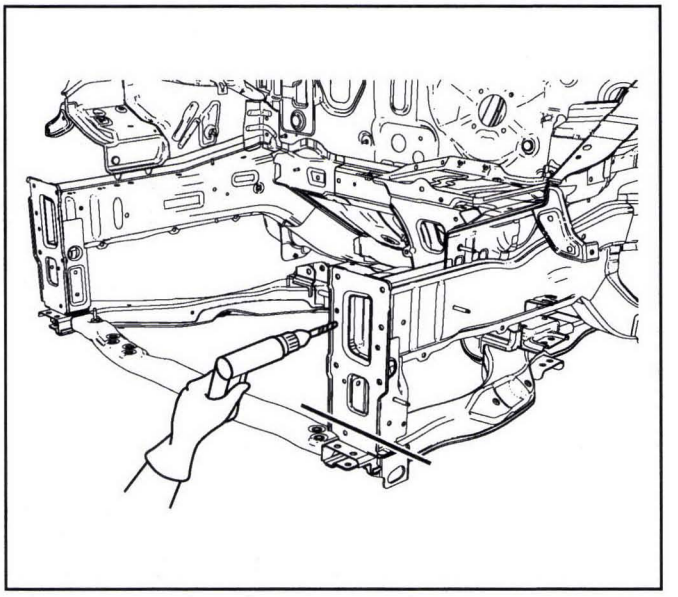
6. Create cut lines on the drivetrain and front suspension frame front support.



2355473

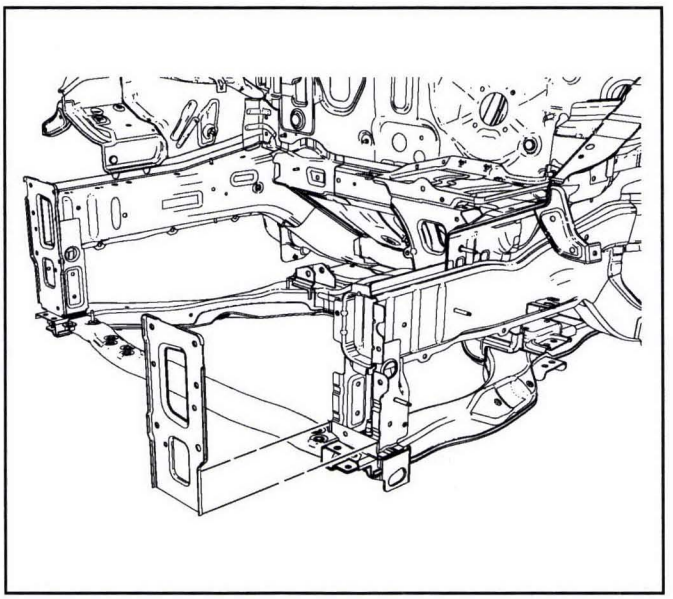
Note: Do not damage any inner panels or reinforcements.

7. Cut the panel where sectioning is to be performed.



2355474

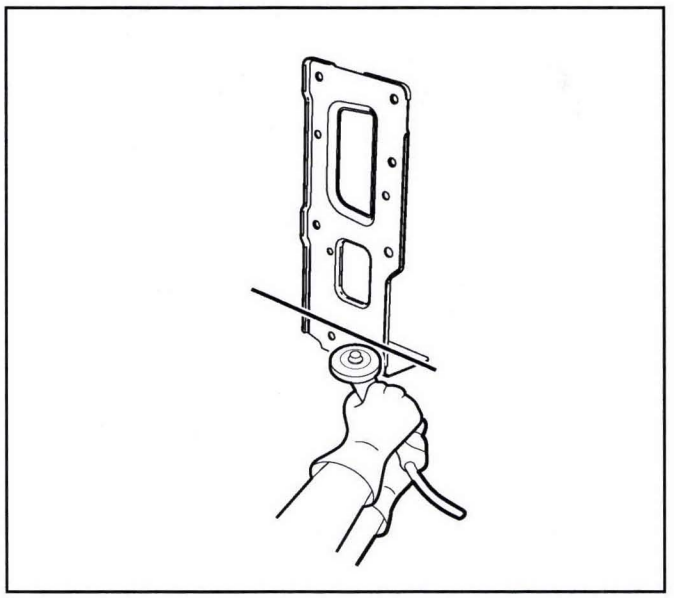
8. Locate and mark all the necessary factory welds of the drivetrain and front suspension frame front support.
9. Drill all factory welds. Note the number and location of welds for installation of the service assembly.



2355476

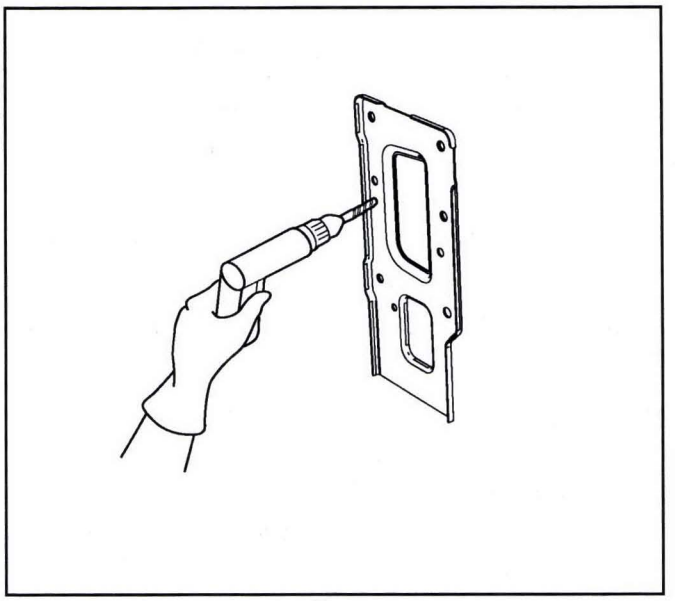
10. Remove the damaged drivetrain and front suspension frame front support.

Installation Procedure



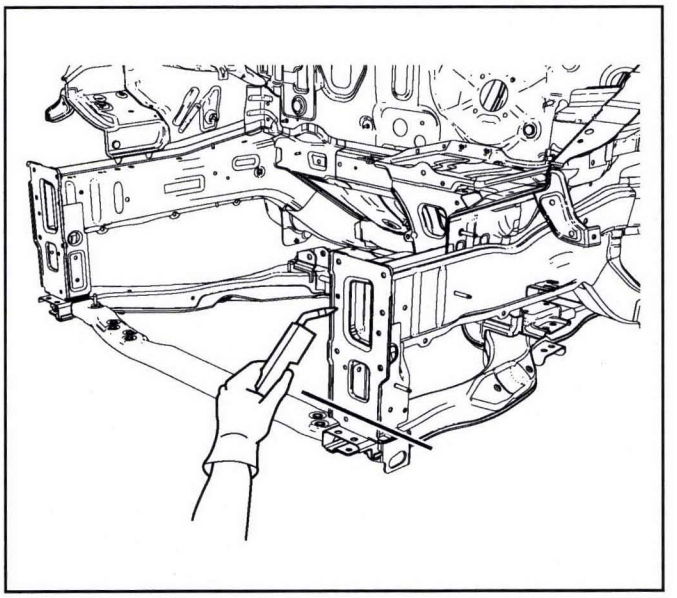
2355477

1. Cut the drivetrain and front suspension frame front support in corresponding locations to fit the remaining original panel. The sectioning joint should be trimmed to allow a gap of one-and-one-half-times the metal thickness at the sectioning joint.
2. Create a 50 mm (2 in) backing plate from the unused portion of the service part.
3. Drill 8 mm (5/16 in) along the sectioning cut on the remaining original part. Locate these holes 13 mm (1/2 in) from the edge of part and spaced 40 mm (11/2 in) apart.
4. Prepare all mating surfaces as necessary.
5. Fit the backing plates halfway into the sectioning joints, clamp in place and plug weld to the vehicle.
6. Align the drivetrain and front suspension frame front support.



2355479

7. Drill 8 mm (5/16 in) for plug welding along the edges of the front suspension frame front support as noted from the original panel.
8. Clean and prepare the attaching surfaces for welding.
9. Position the front suspension frame front support on the vehicle.
10. Verify the fit of the front suspension frame front support.
11. Clamp the front suspension frame front support into position.



2355480

12. Plug weld accordingly.
13. To create a solid weld with minimum heat distortion, make 25 mm (1 in) stitch welds along the seam with 25 mm (1 in) gaps between them. Then go back and complete the stitch weld.

14. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
15. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
16. Install all related panels and components.
17. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
18. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

Front Compartment Side Rail Bracket Replacement

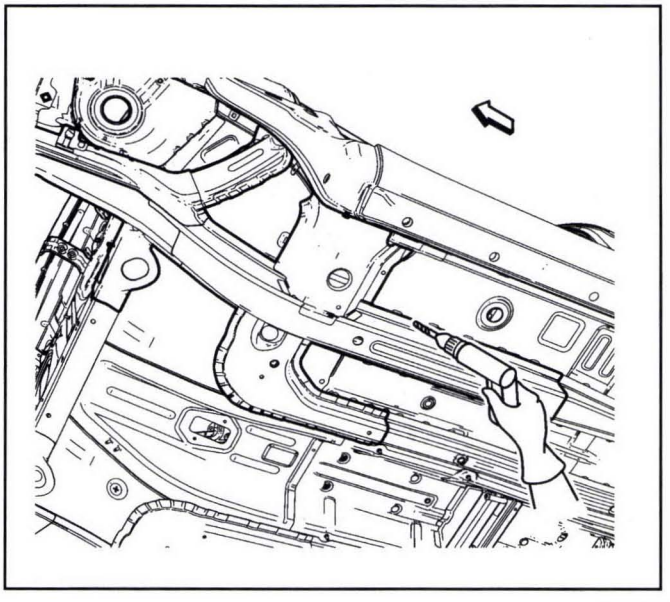
Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3.

Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5.

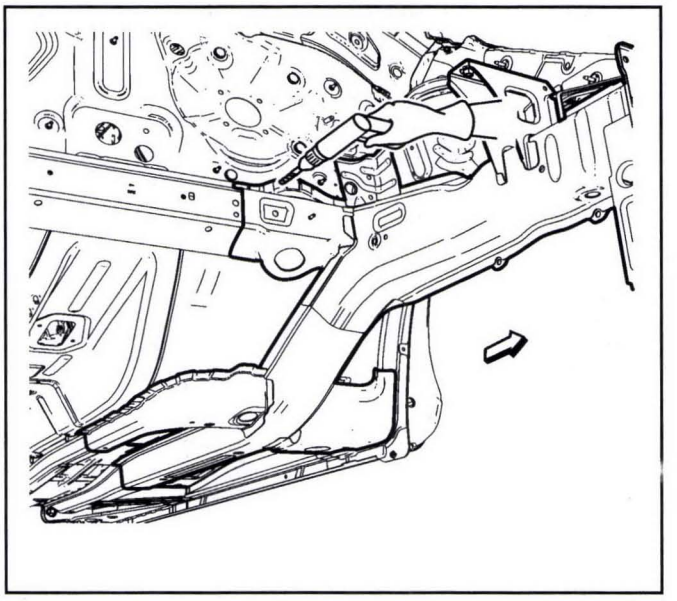
Note: In the Removal Procedure, steps 6, 7 and 8 are exactly the same except with different graphics.

1. Disable the SIR System. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all the related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.



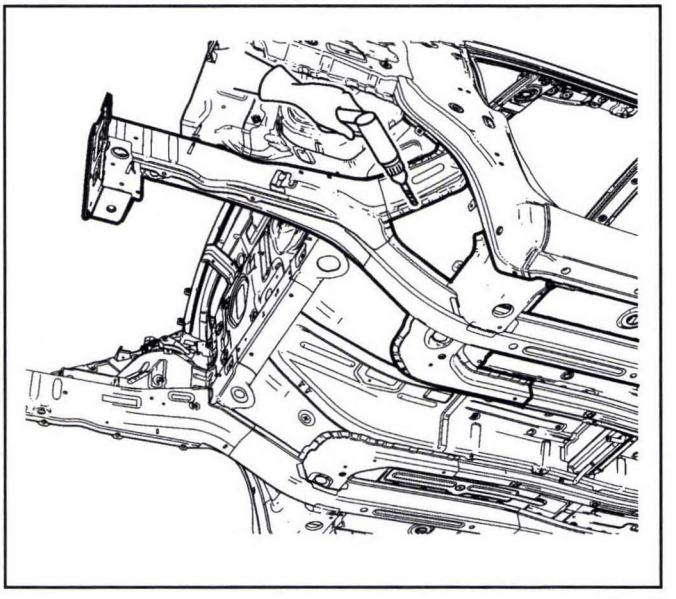
2327516

6. Locate and mark all the necessary factory welds and weld seams of the front compartment side rail.



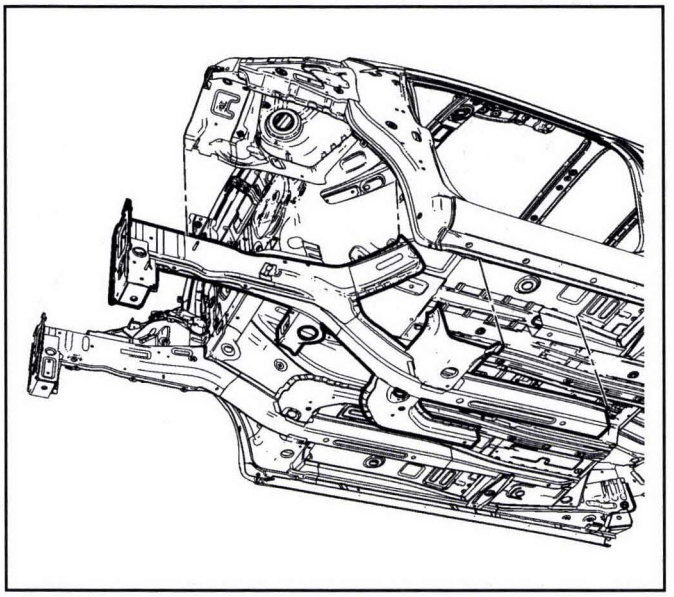
2327513

7. Locate and mark all the necessary factory welds and weld seams of the front compartment side rail.



2327511

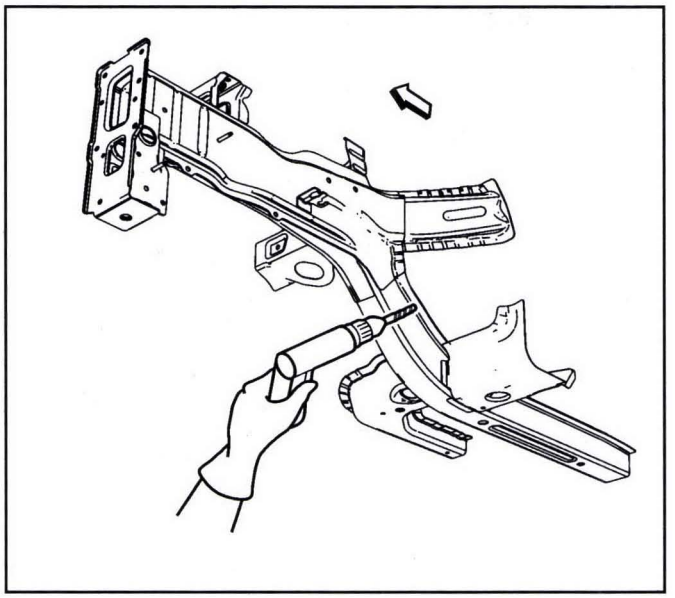
8. Locate and mark all the necessary factory welds and weld seams of the front compartment side rail.



2327509

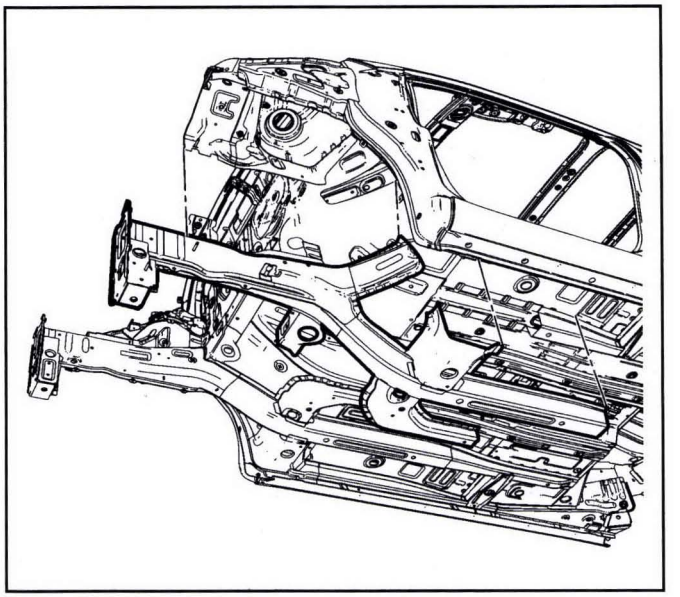
9. Remove the front compartment side rail wheelhouse panel.

Installation Procedure



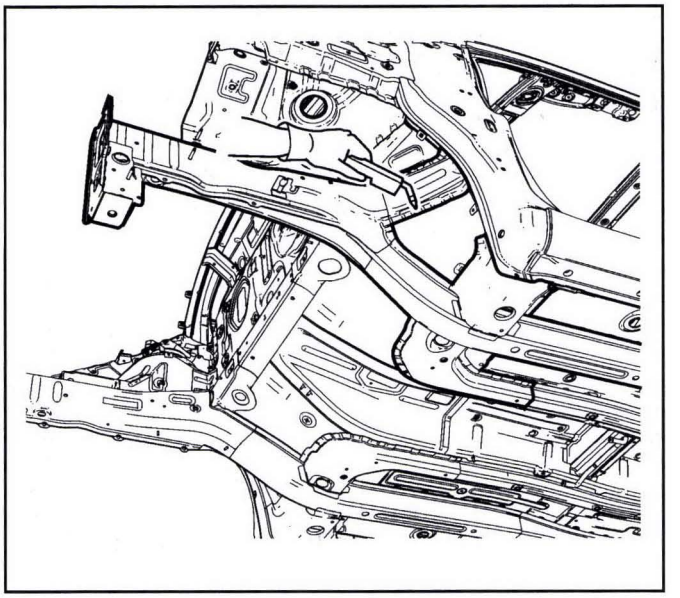
2327506

1. Drill 8 mm (5/16 in) for plug welding along the edges of the front compartment side rail as noted from the original panel.
2. Clean and prepare the attaching surfaces for welding.



2327509

3. Position the front compartment side rail on the vehicle.
4. Verify the fit of the front compartment side rail on the vehicle.
5. Clamp the front compartment side rail into position.



2327496

6. Plug the weld accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
8. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
9. Install all the related panels and components.
10. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
11. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

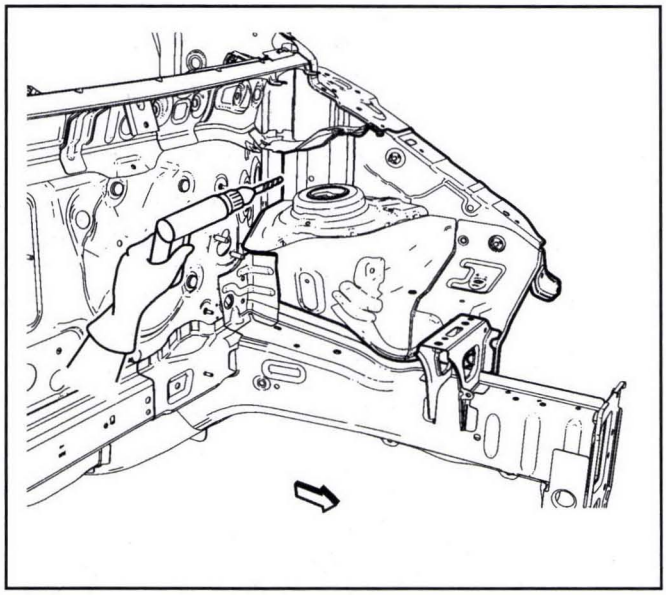
Front Wheelhouse Panel Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3.

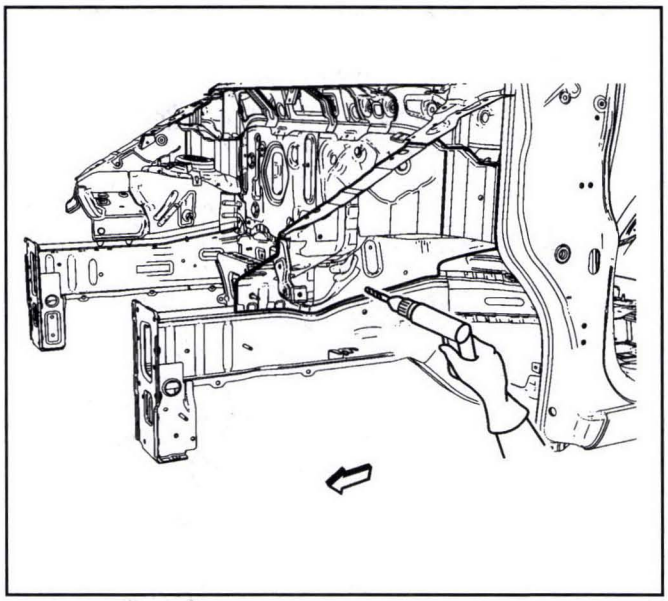
Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5.

1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.



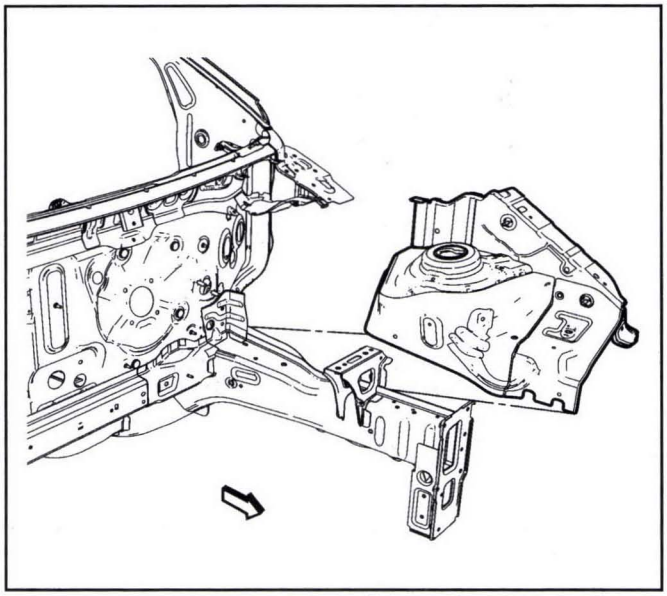
2327549

6. Locate and mark all the necessary factory welds and weld seams of the front wheelhouse panel.



2327542

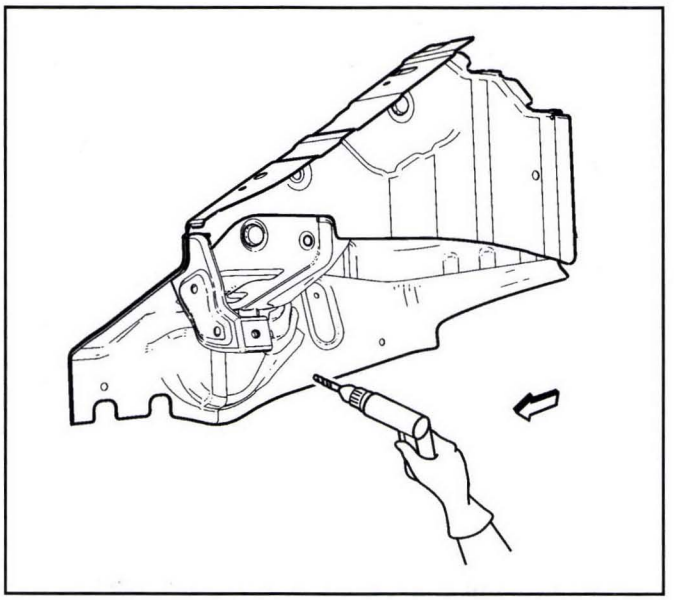
7. Drill all factory welds. Note the number and location of welds for installation of the service assembly.
8. Cut the adhesive in the front area and where the front wheelhouse and the front compartment side rail overlap with an appropriate tool.



2327541

9. Remove the front wheelhouse panel.

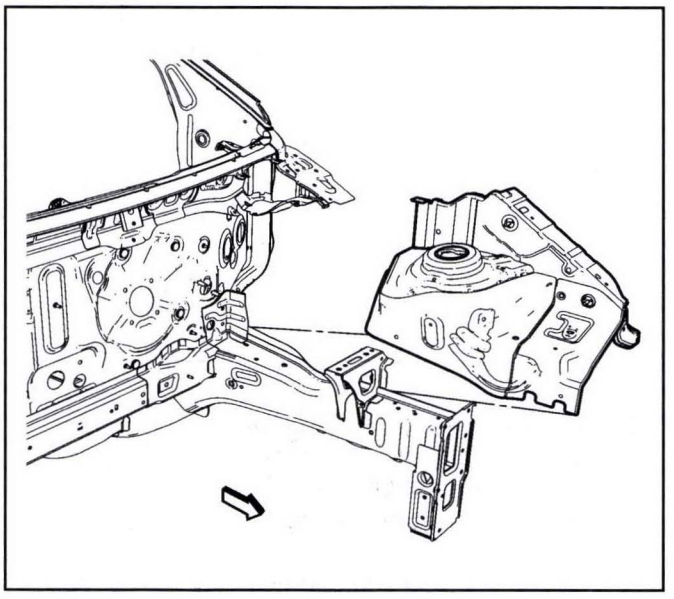
Installation Procedure



2327539

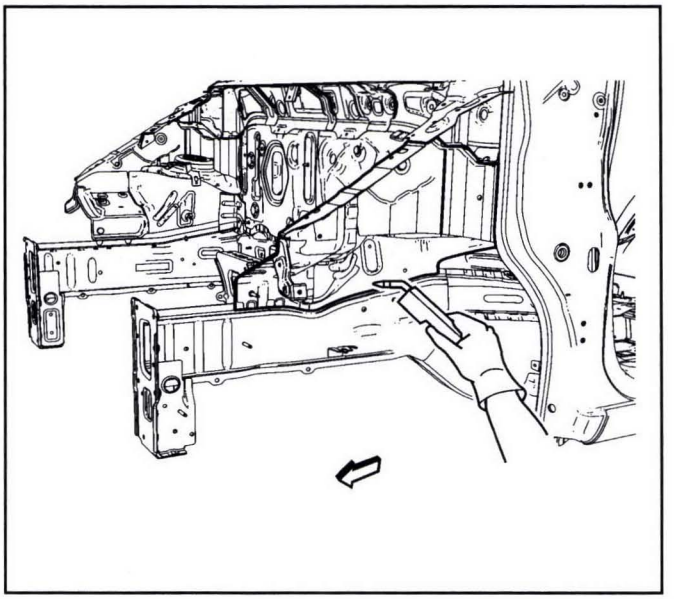
Note: Double the number of drills at the flange where the front wheelhouse panel and front compartment side rail overlap.

1. Drill 8 mm (5/16 in) for plug welding along the edges of the wheelhouse panel as noted from the original panel.
2. Clean and prepare the attaching surfaces for welding.



2327541

3. Position the wheelhouse panel on the vehicle.
4. Verify the fit of the wheelhouse panel on the vehicle.
5. Clamp the wheelhouse panel into position.



2327529

6. Plug weld accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
8. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
9. Install all related panels and components.
10. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
11. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

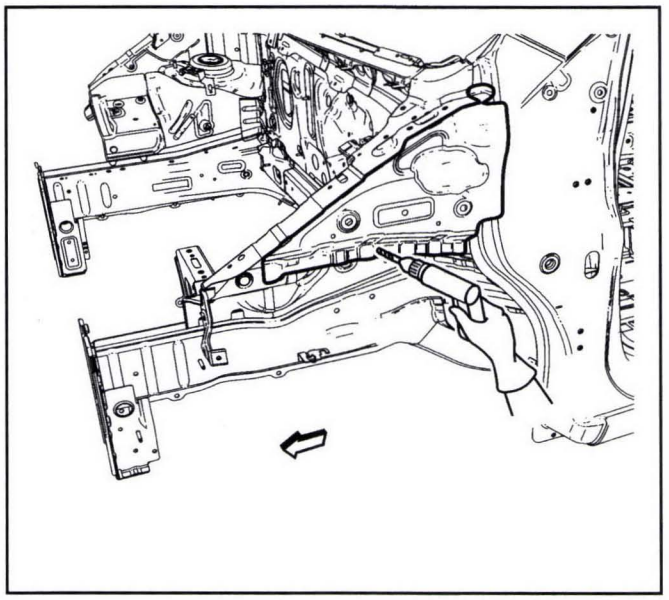
Front Compartment Upper Side Rail Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3.

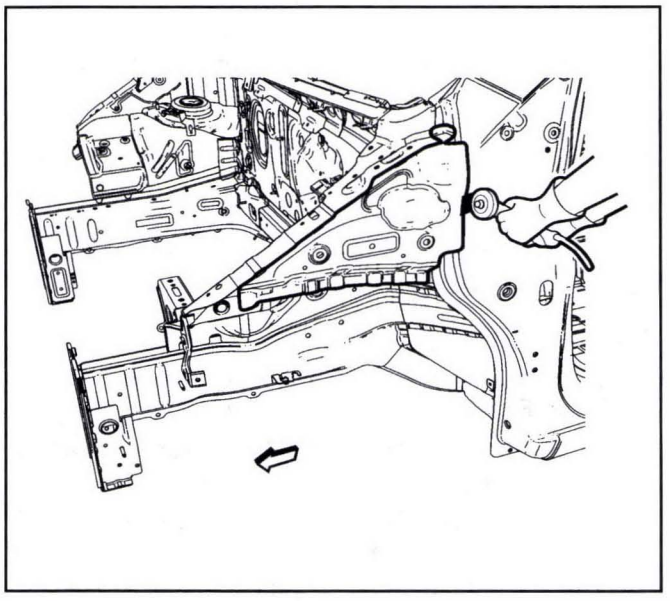
Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5.

1. Disable the SIR System. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.



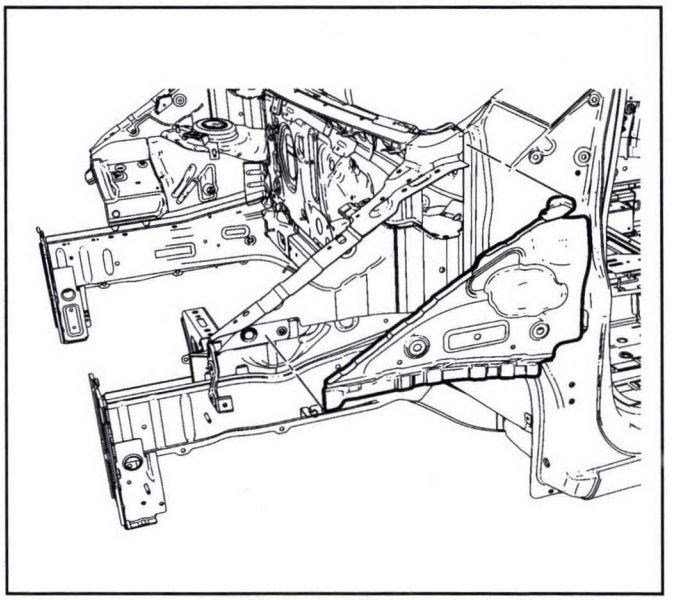
2327526

6. Locate and mark all the necessary factory welds and weld seams of the front compartment upper side rail.
7. Drill all factory welds. Note the number and location of welds for installation of the service assembly.



2327524

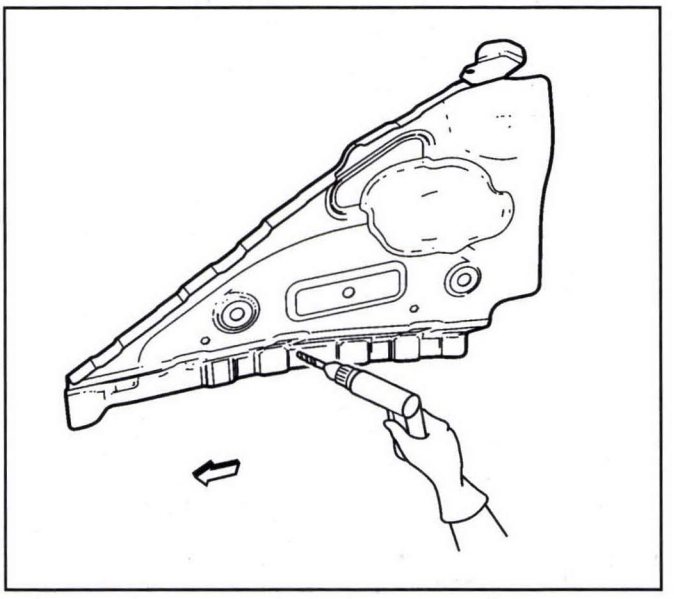
8. Grind factory weld seams.



2327522

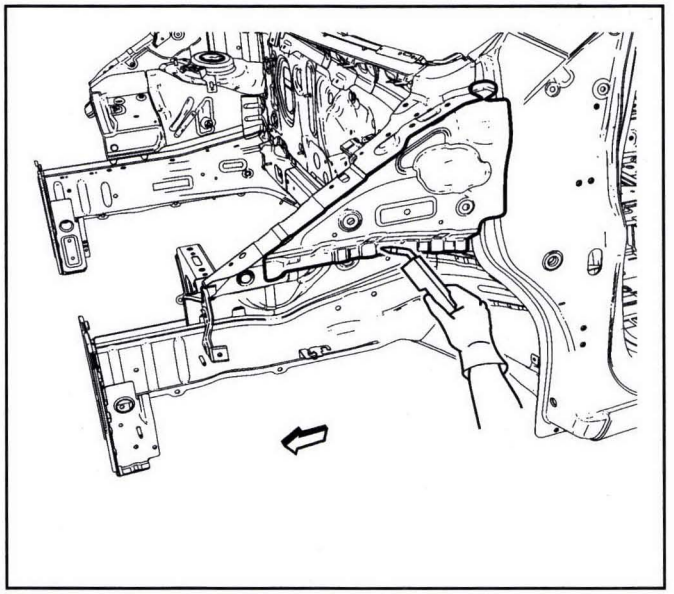
9. Remove the front compartment upper side rail.

Installation Procedure



2327519

1. Drill 8 mm (5/16 in) for plug welding along the edges of the front compartment upper side rail as noted from the original panel.
2. Clean and prepare the attaching surfaces for welding.
3. Position the front compartment upper side rail on the vehicle.
4. Verify the fit of the front compartment upper side rail.
5. Clamp the front compartment upper side rail into position.



2327517

Note: Plug weld factory slots in the front hinge pillar body area (1) as noted from the original panel.

6. Plug weld accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
8. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
9. Install all related panels and components.
10. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
11. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

Front Hinge Pillar Body Sectioning

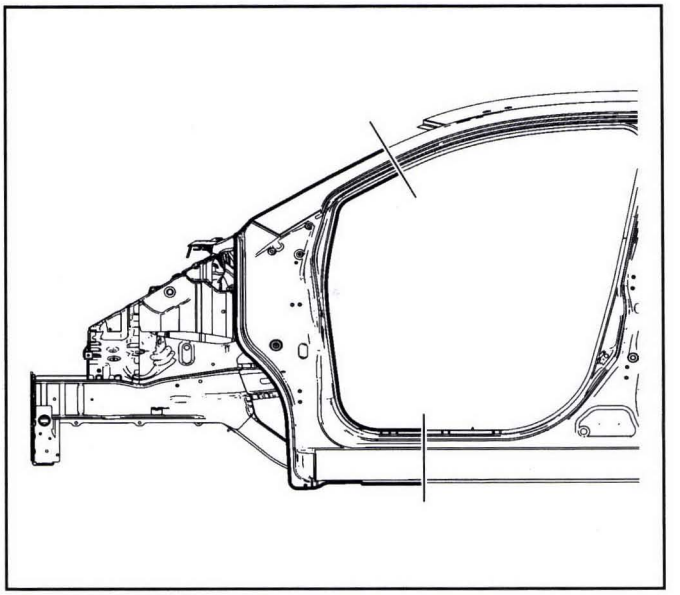
Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3.

Warning: Refer to Collision Sectioning Warning on page 0-4.

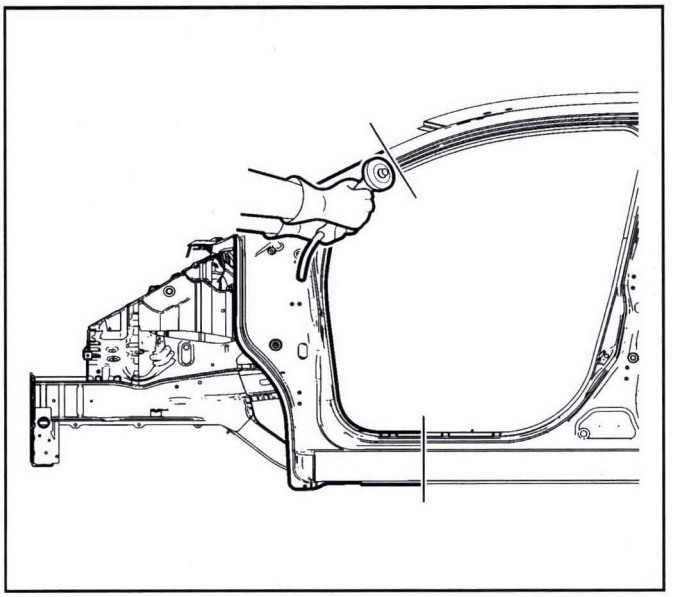
Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5.

1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all the related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.



2327448

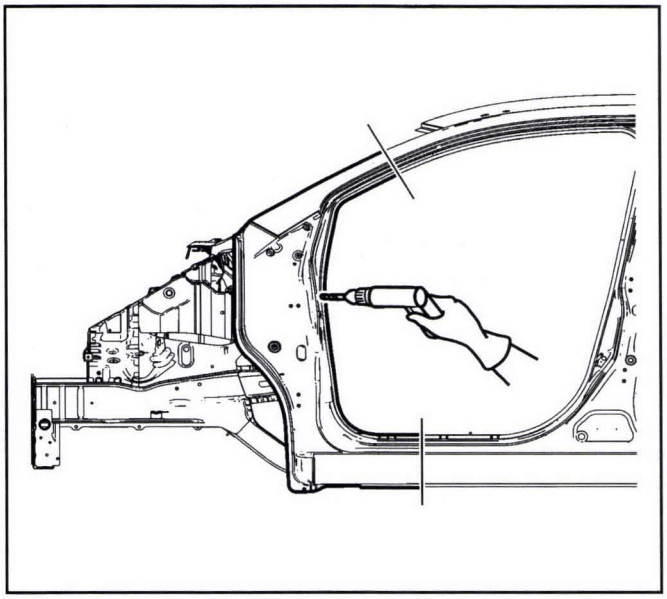
6. Create cut lines on the front hinge pillar body.



2327445

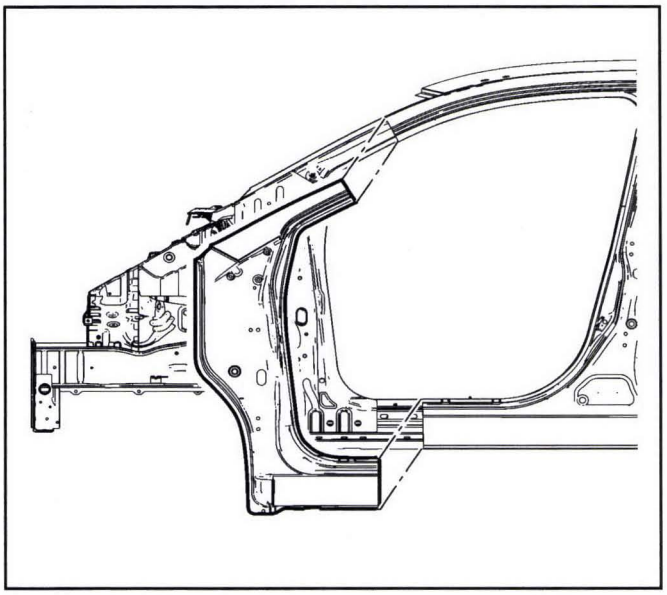
Note: Do not damage any inner panels or reinforcements.

7. Cut the panel where sectioning is to be performed.



2327443

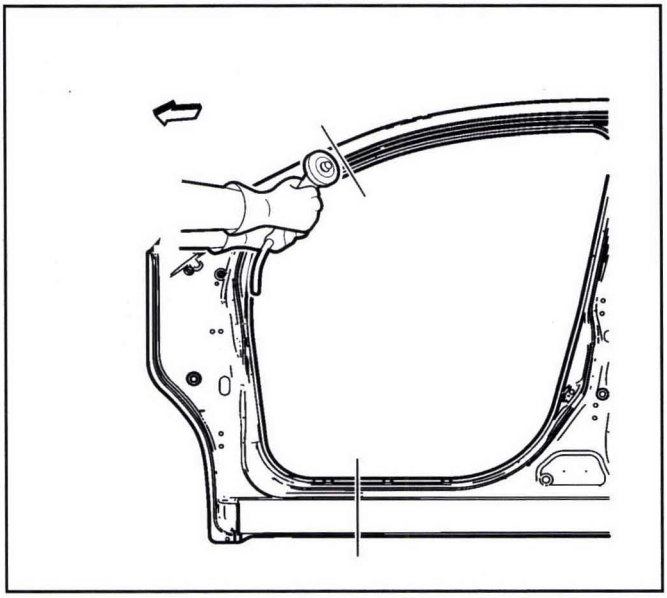
8. Locate and mark all the necessary factory welds of the front hinge pillar body.
9. Drill all the factory welds. Note the number and location of welds for installation of the service assembly.



2327440

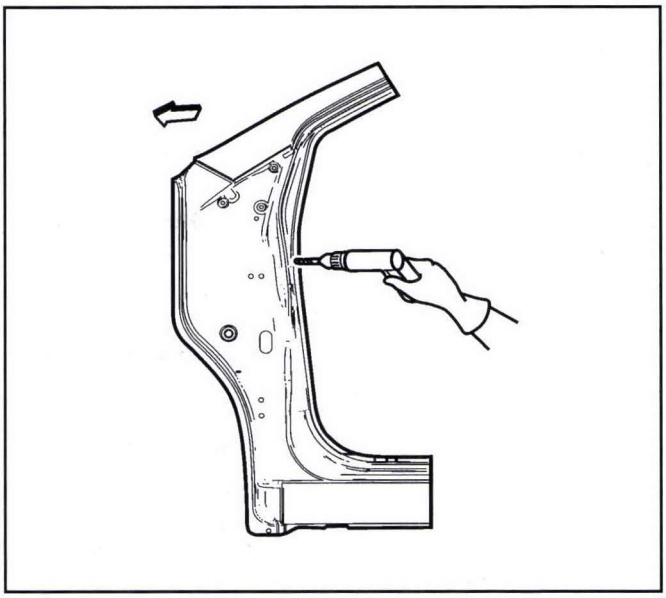
10. Remove the damaged front hinge pillar body.

Installation Procedure



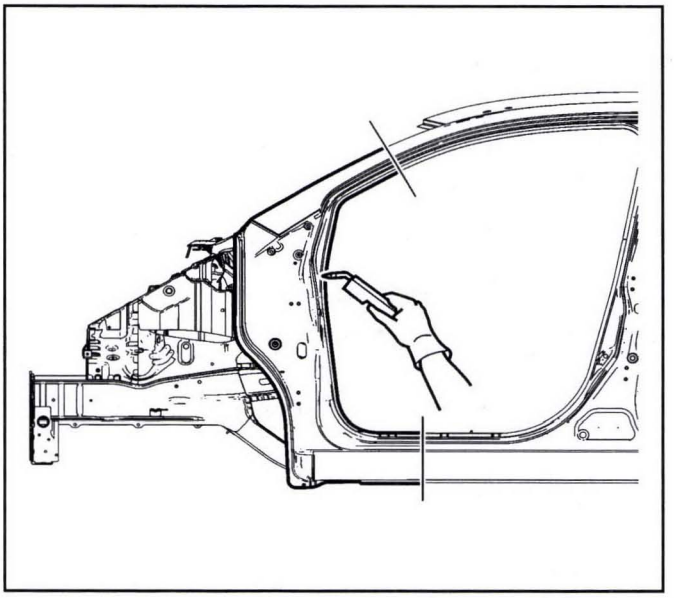
2327438

1. Cut the front hinge pillar body in corresponding locations to fit the remaining original panel. The sectioning joint should be trimmed to allow a gap of one-and-one-half-times the metal thickness at the sectioning joint.
2. Create a 50 mm (2 in) backing plate from the unused portion of the service part.
3. Drill 8 mm (5/16 in) along the sectioning cut on the remaining original part. Locate these holes 13 mm (1/2 in) from the edge of part and spaced 40 mm (11/2 in) apart.
4. Prepare all mating surfaces as necessary.
5. Fit the backing plates halfway into the sectioning joints, clamp in place and plug weld to the vehicle.
6. Align the front hinge pillar body.



2327434

7. Drill 8 mm (5/16 in) for plug welding along the edges of the front hinge pillar body as noted from the original panel.
8. Clean and prepare the attaching surfaces for welding.
9. Position the front hinge pillar body on the vehicle.
10. Verify the fit of the front hinge pillar body.
11. Clamp the front hinge pillar body into position.



2327432

12. Plug the weld accordingly.
13. To create a solid weld with minimum heat distortion, make 25 mm (1 in) stitch welds along the seam with 25 mm (1 in) gaps between them. Then go back and complete the stitch weld.
14. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
15. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
16. Install all the related panels and components.
17. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
18. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

Body Hinge Pillar Lower Reinforcement Replacement

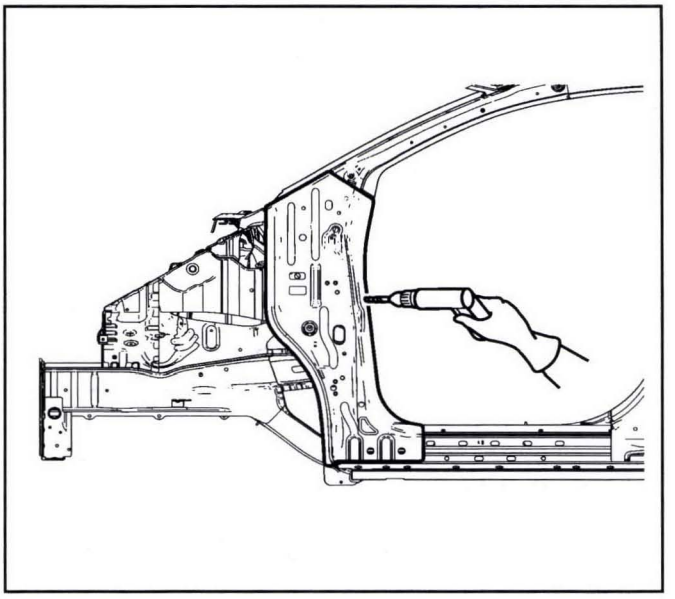
Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3.

Warning: Refer to Collision Sectioning Warning on page 0-4.

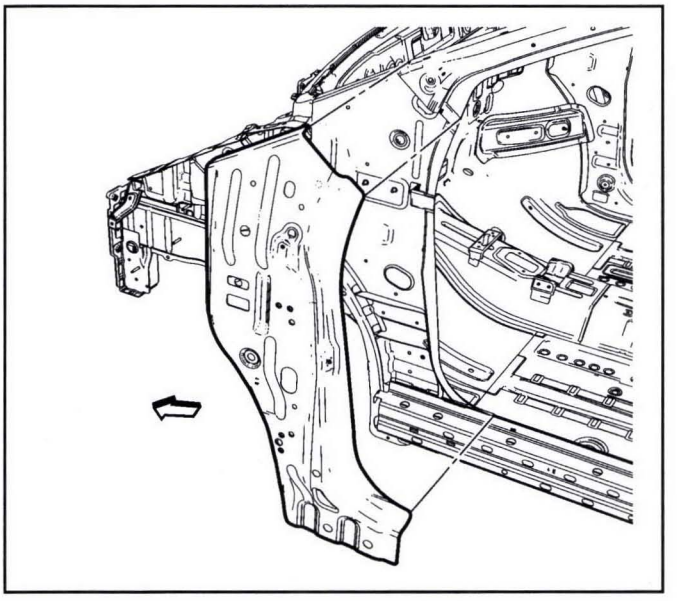
Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5.

1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.



2327566

6. Locate and mark all the necessary factory welds and weld seams of the front hinge pillar body.
7. Drill all factory welds. Note the number and location of welds for installation of the service assembly.

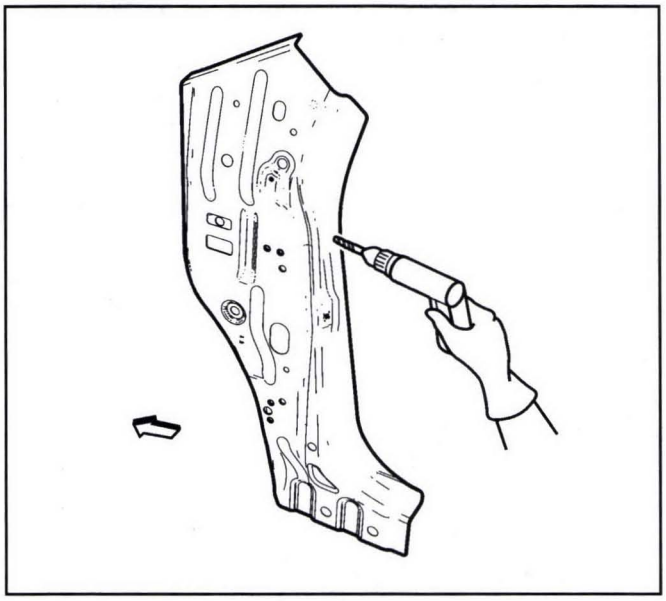


2327562

8. Remove the damaged front hinge pillar body reinforcement.

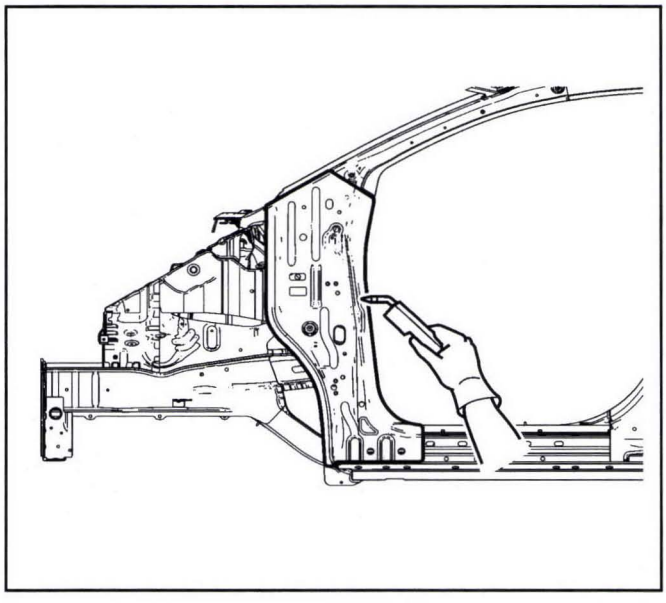
Installation Procedure

1. Prepare all mating surfaces as necessary.
2. Align the front hinge pillar body reinforcement.



2327560

3. Drill 8 mm (5/16 in) for plug welding along the edges of the front hinge pillar body as noted from the original panel.
4. Clean and prepare the attaching surfaces for welding.
5. Position the front hinge pillar body reinforcement on the vehicle.
6. Verify the fit of the front hinge pillar body reinforcement.
7. Clamp the front hinge pillar body reinforcement into position.



2327558

8. Plug weld accordingly.
9. To create a solid weld with minimum heat distortion, make 25 mm (1 in) stitch welds along the seam with 25 mm (1 in) gaps between them. Then go back and complete the stitch weld.
10. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
11. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
12. Install all related panels and components.
13. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
14. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

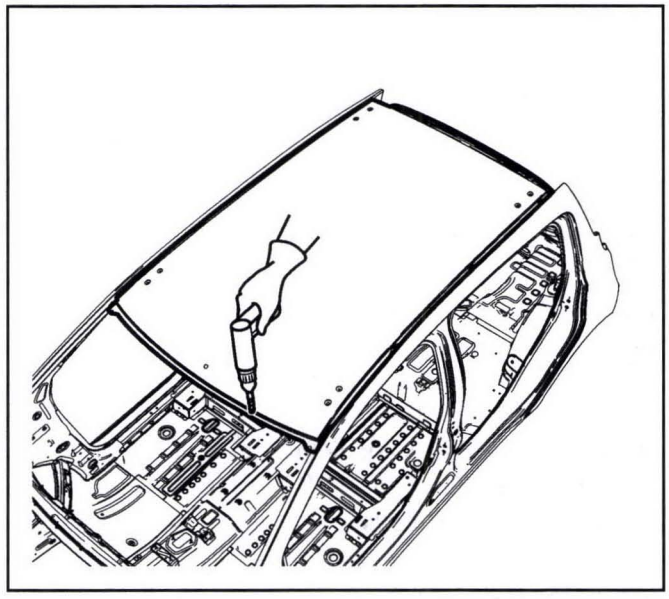
Roof Outer Panel Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3.

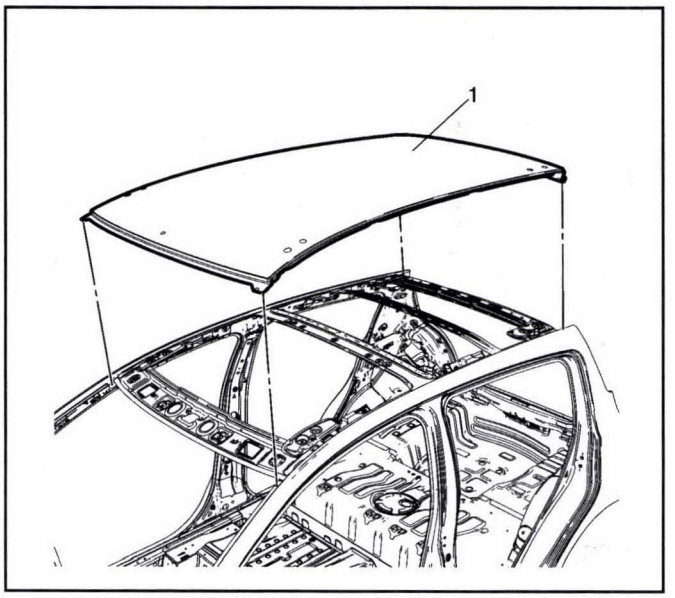
Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5.

1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
6. Locate and mark all factory welds.



2327555

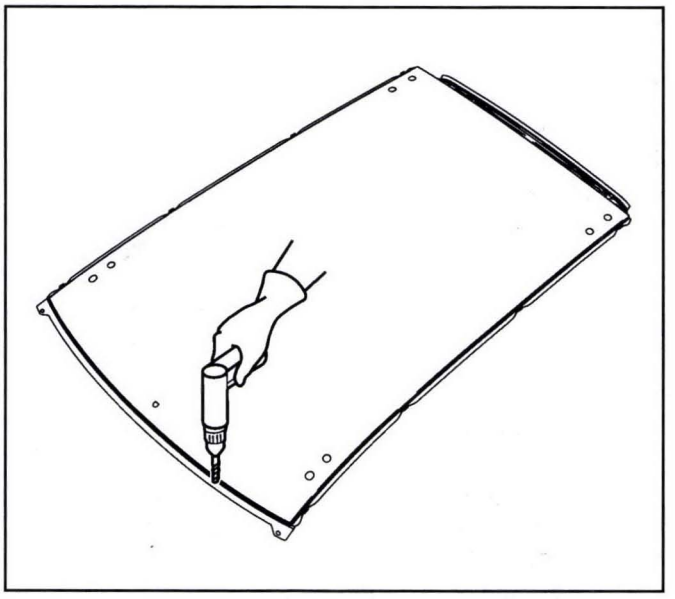
7. Drill all factory welds. Note the number and location of welds for installation of the service assembly.
8. Cut the adhesive with an appropriate tool.



2327553

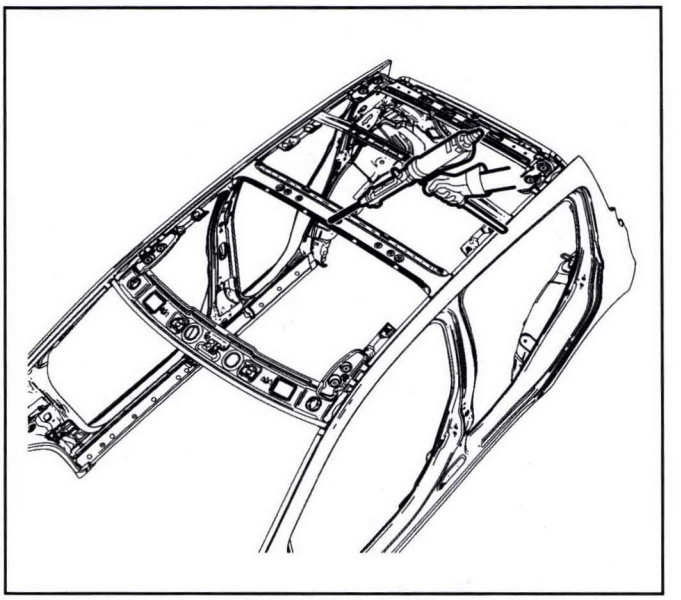
9. Remove the damaged roof panel (1).

Installation Procedure



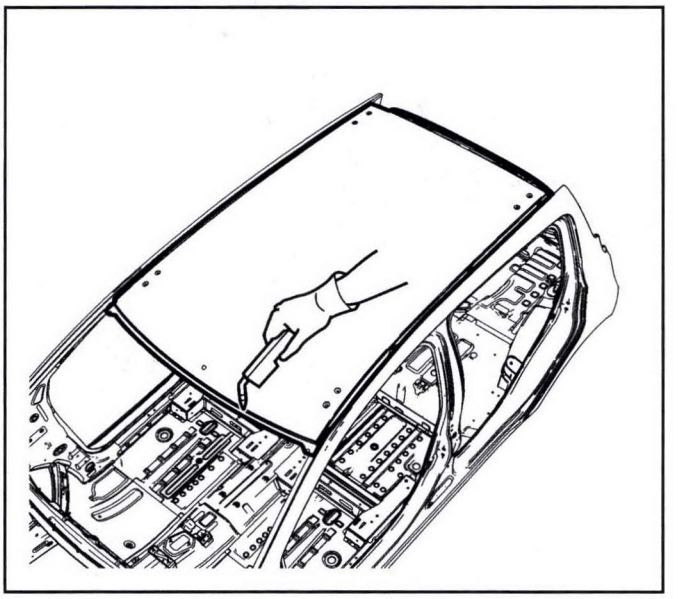
2327551

1. Drill 8 mm (5/16 in) for plug welding along the edges of the service panel as noted from the original panel.
2. Clean and prepare the attaching surfaces for welding.



2327492

3. Apply one-part windshield urethane adhesive as noted from the original panel.
4. Position the roof panel on the vehicle.
5. Verify the fit of the panel.
6. Clamp the panel into position.



2327489

7. Plug weld accordingly.
8. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
9. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
10. Install all related panels and components.
11. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
12. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

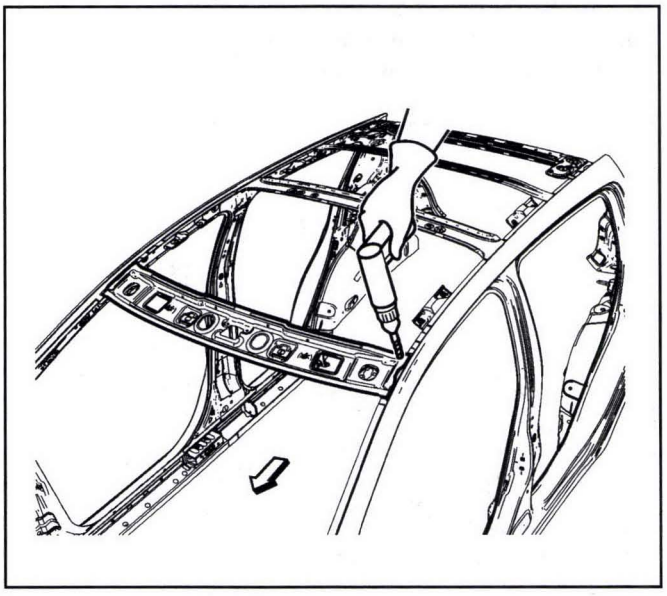
Roof Front Header Panel Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3.

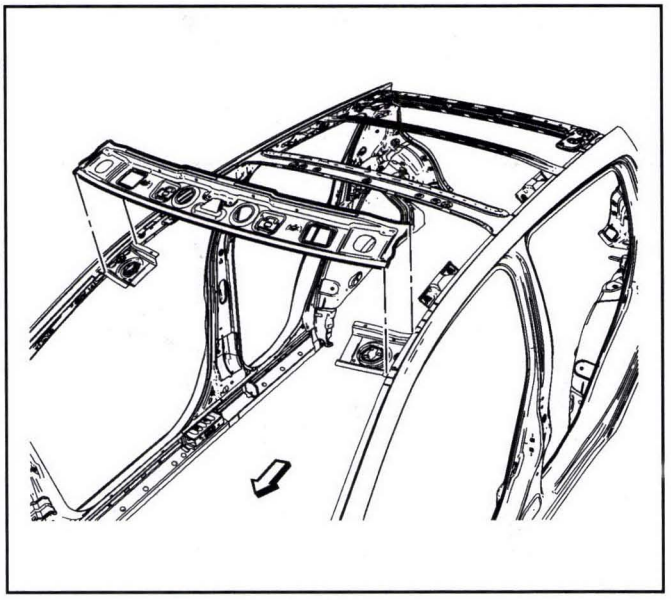
Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5.

1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
6. Locate and mark all factory welds.



2327488

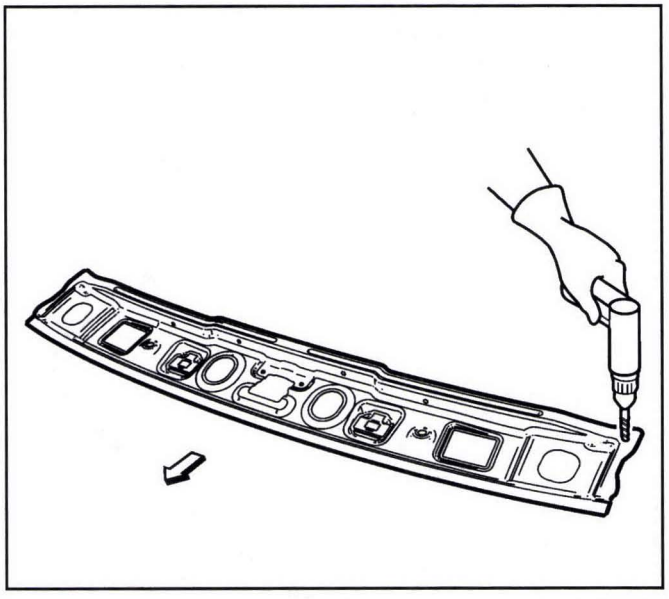
7. Drill all factory welds. Note the number and location of welds for installation of the service assembly.



2327486

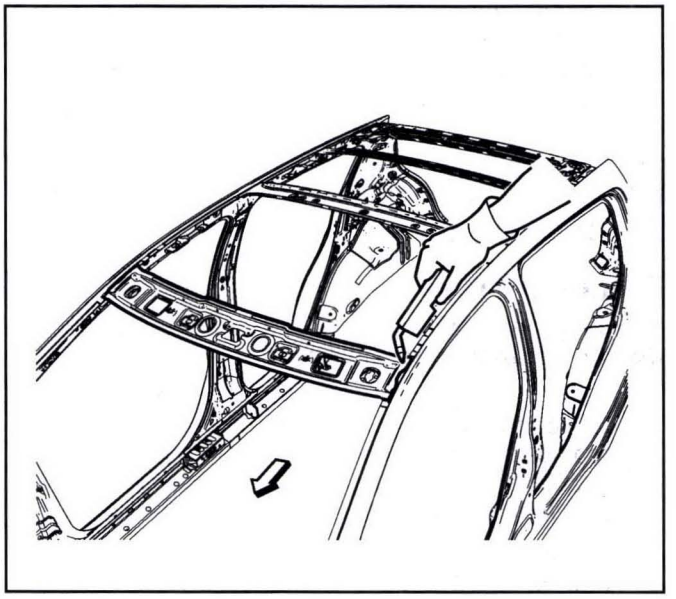
8. Remove the damaged roof front header panel.

Installation Procedure

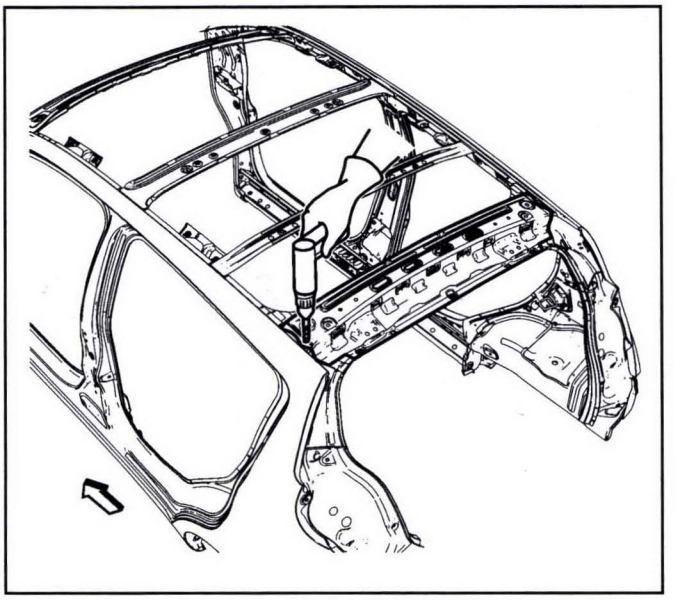


2327485

1. Drill 8 mm (5/16 in) for plug welding along the edges of the service panel as noted from the original panel.
2. Clean and prepare the attaching surfaces for welding.
3. Position the roof front header panel.
4. Verify the fit of the panel.
5. Clamp the panel into position.



2327482



2327480

6. Plug weld accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
8. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
9. Install all related panels and components.
10. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
11. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

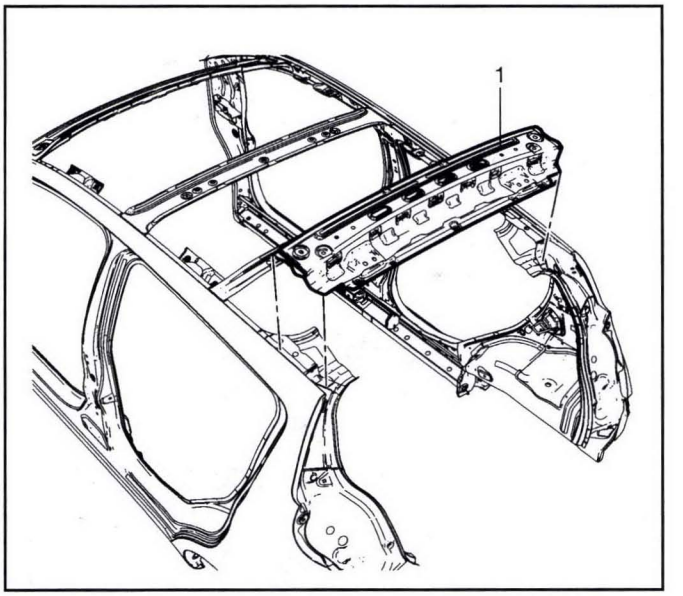
Roof Rear Header Panel Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3.

Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5.

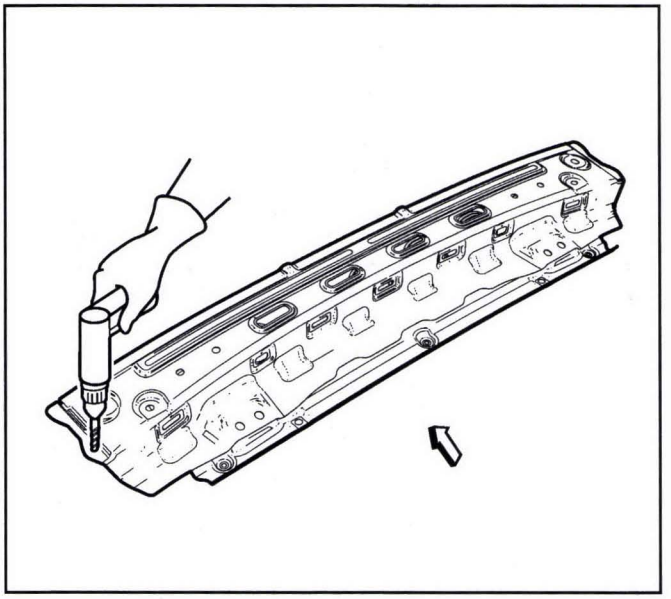
1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
6. Locate and mark all factory welds.
7. Drill all factory welds. Note the number and location of welds for installation of the service assembly.



2327478

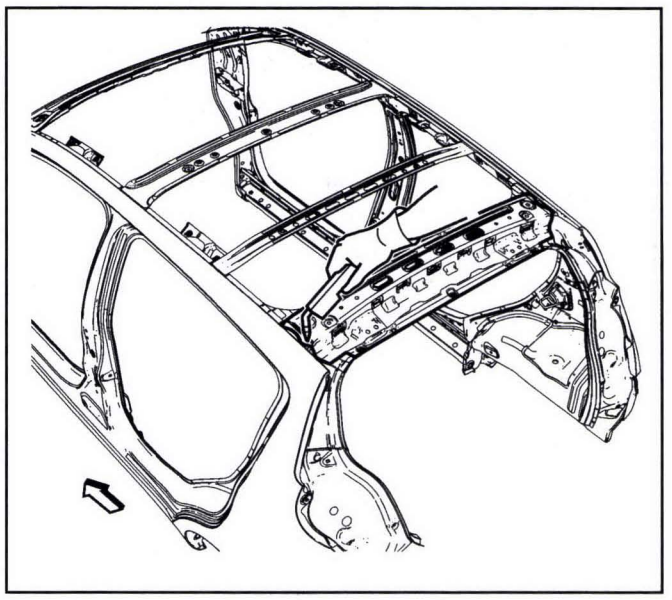
8. Remove the damaged rear header panel (1).

Installation Procedure



2327475

1. Drill 8 mm (5/16 in) for plug welding along the edges of the service panel as noted from the original panel.
2. Clean and prepare the attaching surfaces for welding.
3. Position the roof rear header panel.
4. Verify the fit of the panel.
5. Clamp the panel into position.



2327473

6. Plug weld accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
8. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
9. Install all related panels and components.
10. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
11. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

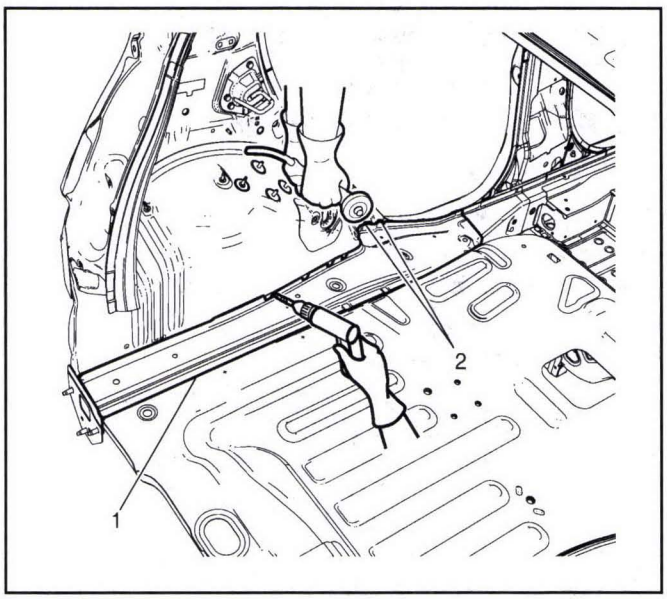
Rear Compartment Floor Panel Rail Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3.

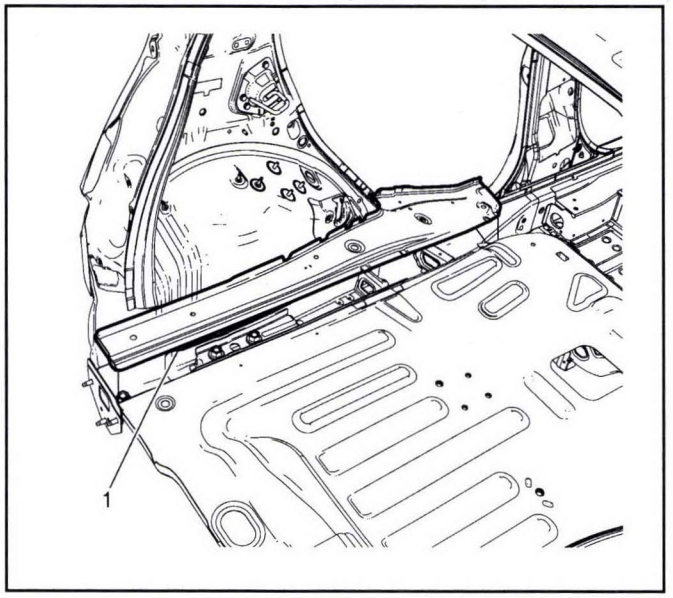
Note: The rear compartment floor panel rail is made of Ultra High Strength Steel and should be replaced only at factory joints. Repairing or sectioning of this part is not recommended. Refer to *Ultra High Strength Steel on page 3-116*.

1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all related panels and components.
4. Repair as much of the damage as possible to factory specifications. Refer to *Dimensions - Body on page 3-68*.
5. Remove the sealers and anti-corrosion materials from the repair area. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
6. Locate and mark all factory welds.



3247919

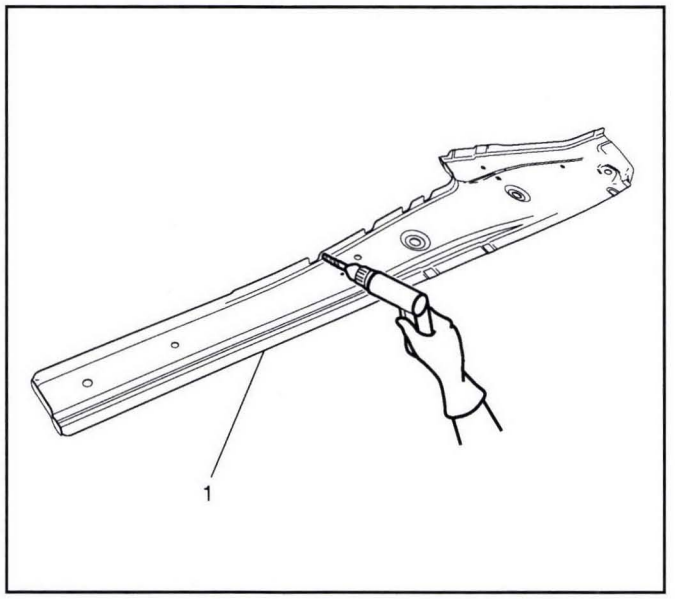
7. Drill all factory welds (1). Note the number and location of welds for installation of the service assembly.
8. Grind factory weld seams (2).



3247922

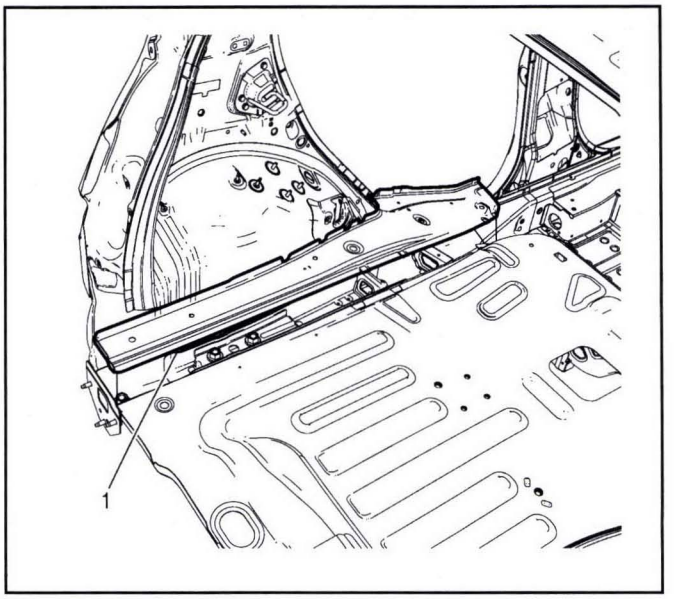
9. Remove the damaged rear compartment floor panel rail (1).

Installation Procedure



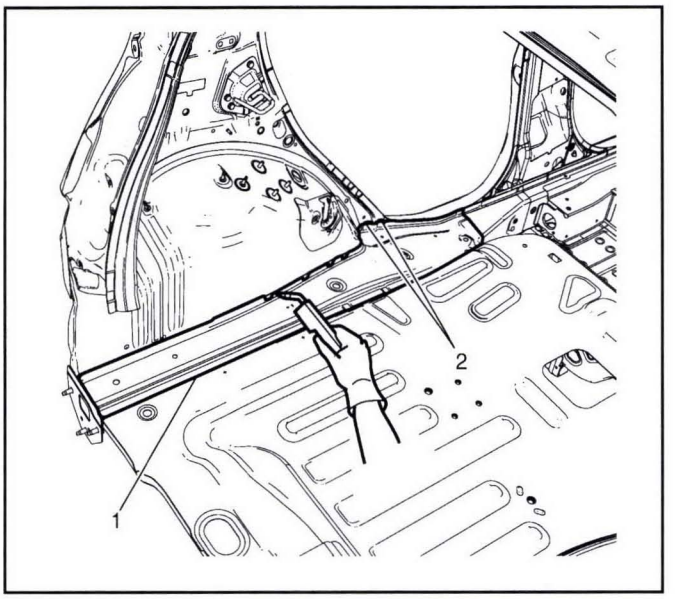
3247924

1. Drill **8 mm (5/16 in)** holes for plug welding along the edges of the service panel as noted from the original panel (1).
2. Clean and prepare the attaching surfaces for welding.



3247922

3. Position the rear compartment floor panel rail (1) panel on the vehicle.
4. Verify the fit of the panel.
5. Clamp the rear compartment floor panel rail into position.



3247927

6. Plug weld accordingly (1).
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
8. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
9. Install all related panels and components.
10. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
11. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

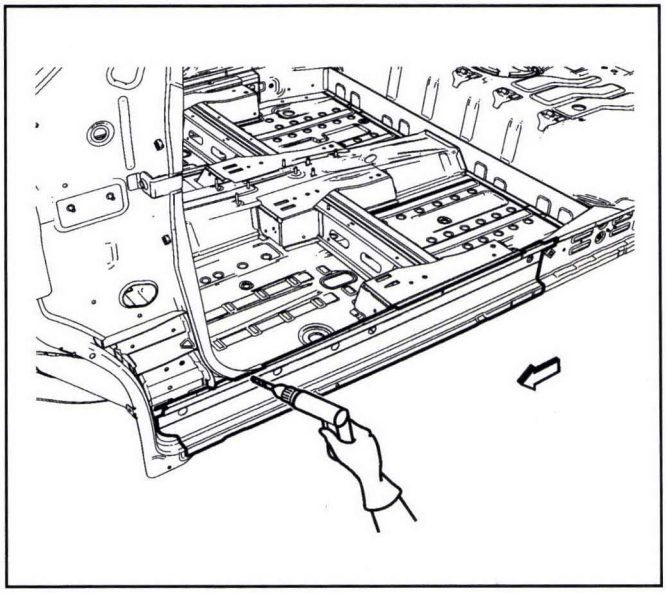
Rocker Inner Panel Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3.

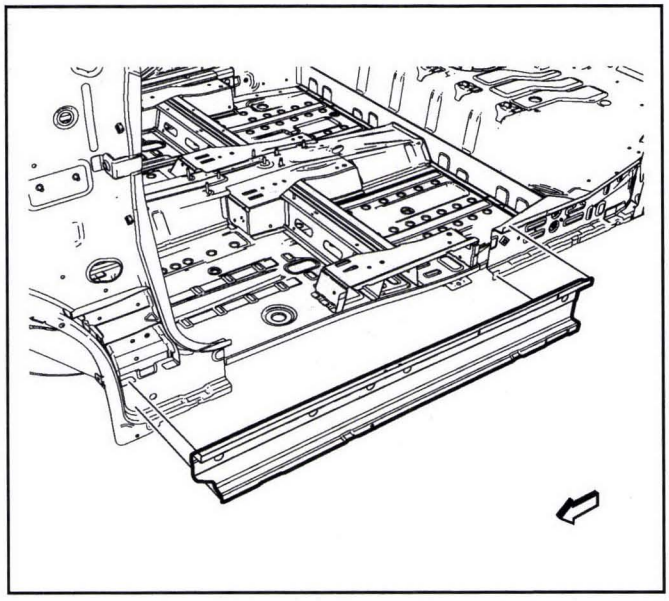
Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5.

1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
6. Locate and mark all factory welds.



2327471

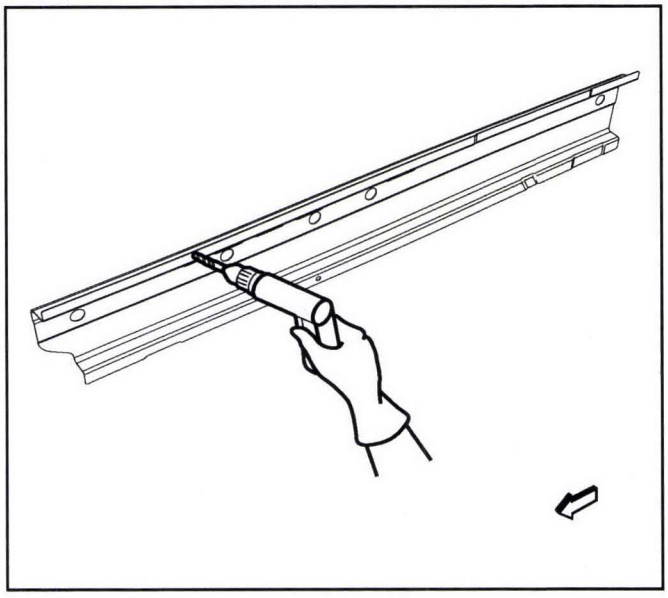
7. Drill all factory welds. Note the number and location of welds for installation of the service assembly.



2327469

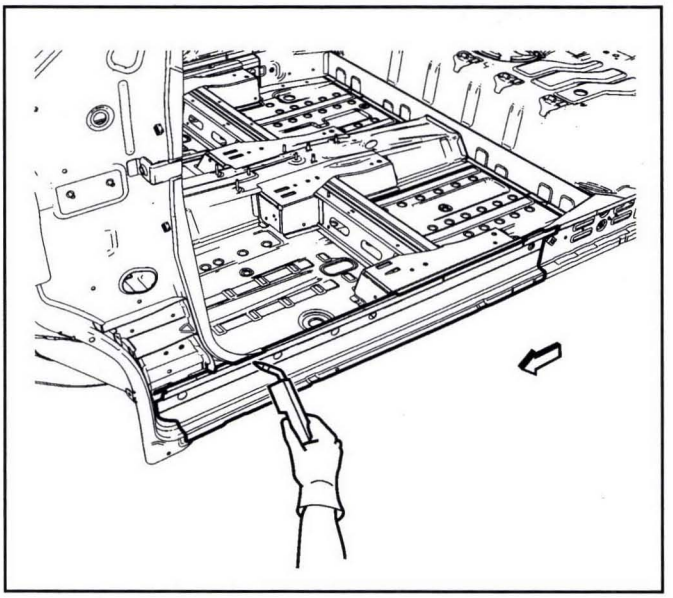
8. Remove the damaged rocker inner panel.

Installation Procedure



2327468

1. Drill 8 mm (5/16 in) for plug welding along the edges of the service panel as noted from the original panel.
2. Clean and prepare the attaching surfaces for welding.
3. Position the rocker inner panel.
4. Verify the fit of the panel.
5. Clamp the panel into position.



2327466

6. Plug the weld accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
8. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
9. Install all related panels and components.
10. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
11. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

Body Lock Pillar Outer Panel Sectioning

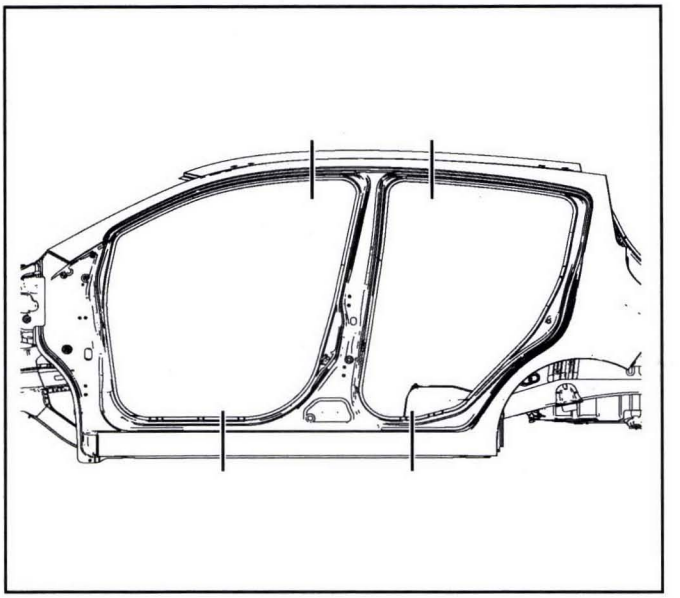
Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3

Warning: Refer to Collision Sectioning Warning on page 0-4

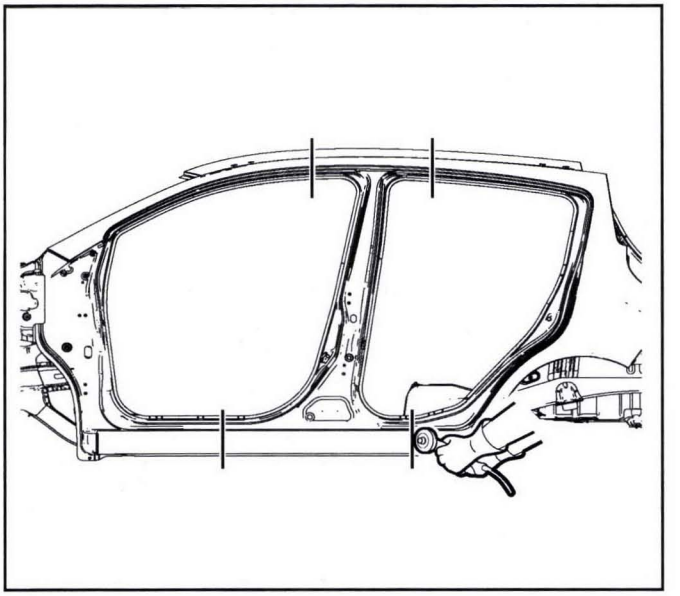
Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5

1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.



2327464

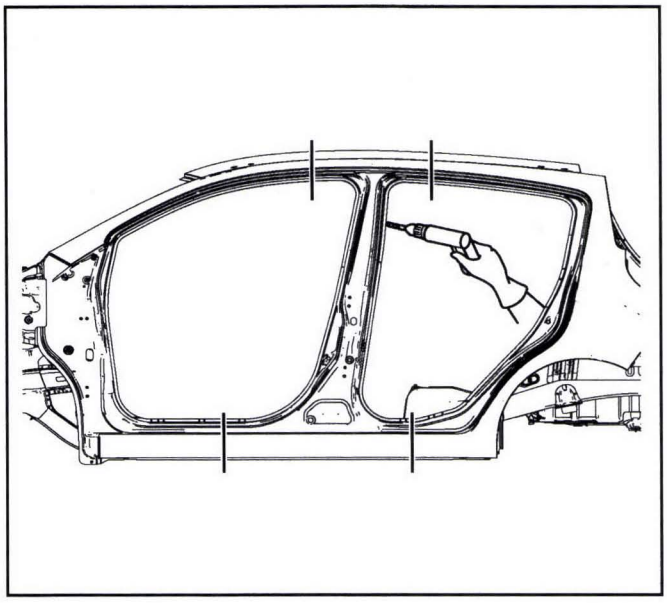
6. Create cut lines on the body lock pillar outer panel.



2327461

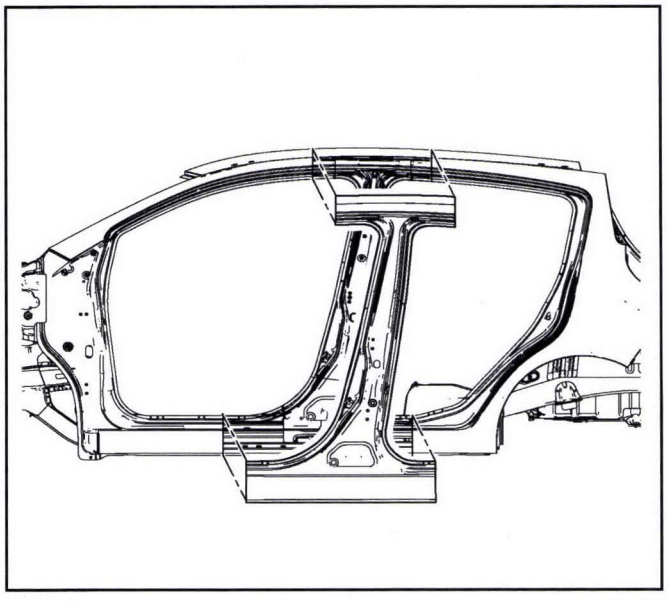
Note: Do not damage any inner panels or reinforcements.

7. Cut the panel where sectioning is to be performed.



2327460

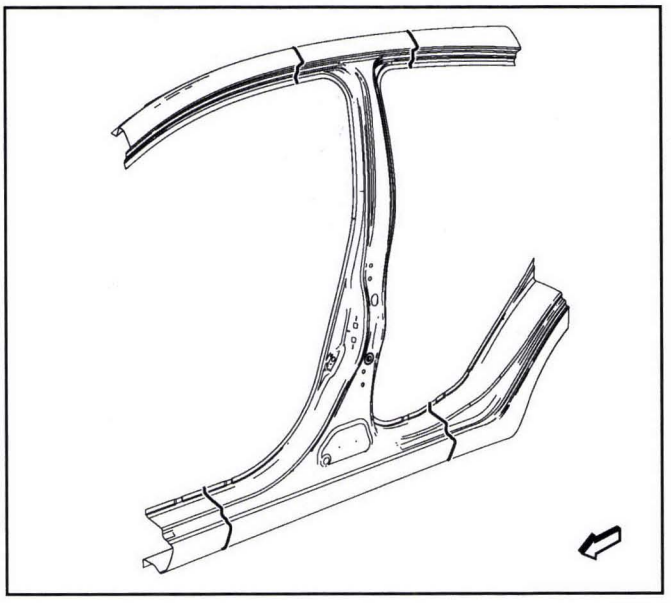
8. Locate and mark all the necessary factory welds of the body lock pillar outer panel.
9. Drill all factory welds. Note the number and location of welds for installation of the service assembly.



2327459

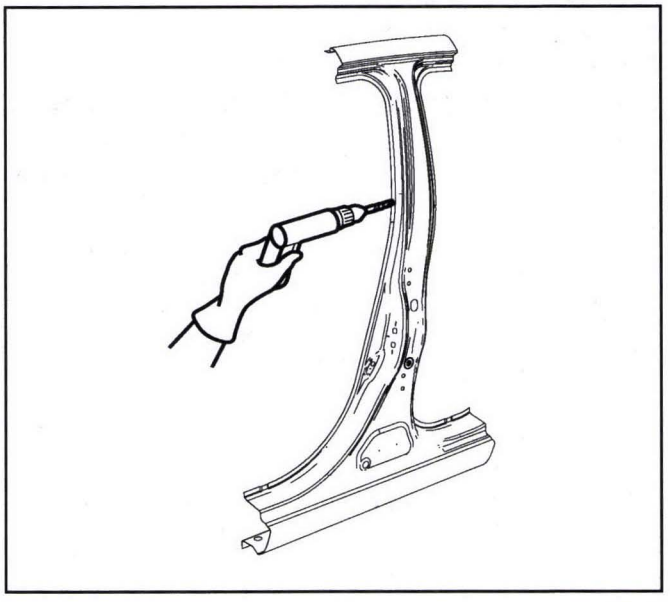
10. Remove the damaged body lock pillar outer panel.

Installation Procedure



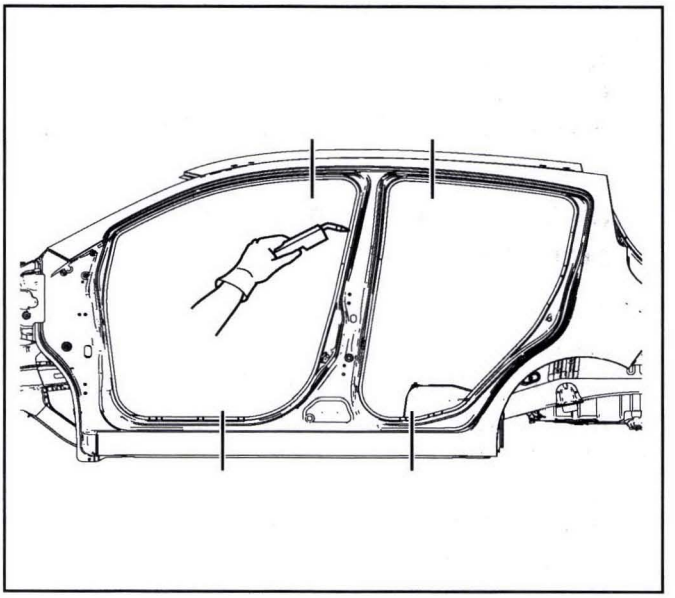
2327457

1. Cut the body lock pillar outer panel in corresponding locations to fit the remaining original panel. The sectioning joint should be trimmed to allow a gap of one-and-one-half-times the metal thickness at the sectioning joint.
2. Create a 50 mm (2 in) backing plate from the unused portion of the service part.
3. Drill a 8 mm (5/16 in) along the sectioning cut on the remaining original part. Locate these holes 13 mm (1/2 in) from the edge of part and spaced 40 mm (1 1/2 in) apart.
4. Prepare all mating surfaces as necessary.
5. Fit the backing plates halfway into the sectioning joints, clamp in place and plug weld to the vehicle.
6. Align the body lock pillar outer panel.



2327455

7. Drill a 8 mm (5/16 in) for plug welding along the edges of the body lock pillar outer panel as noted from the original panel.
8. Clean and prepare the attaching surfaces for welding.
9. Position the body lock pillar outer panel on the vehicle.
10. Verify the fit of the body lock pillar outer panel.
11. Clamp the body lock pillar outer panel into position.



2327454

12. Plug the weld accordingly.
13. To create a solid weld with minimum heat distortion, make a 25 mm (1 in) stitch welds along the seam with 25 mm (1 in) gaps between them. Then go back and complete the stitch weld.
14. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
15. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
16. Install all related panels and components.
17. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
18. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

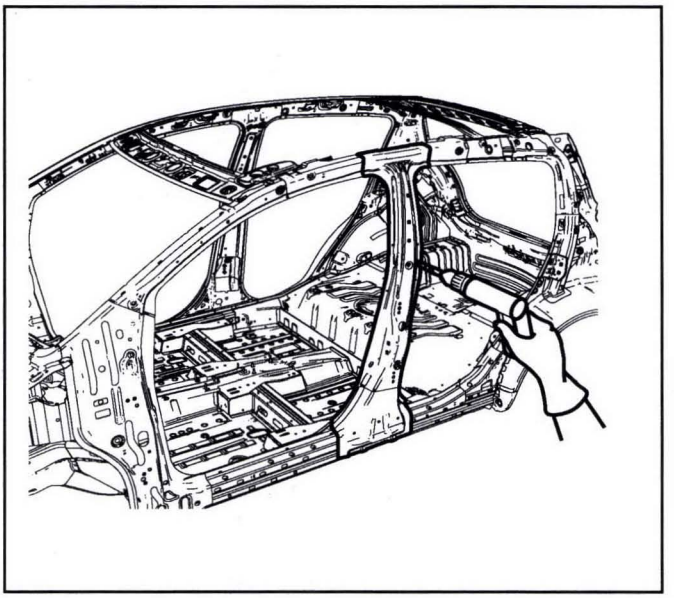
Body Lock Pillar Outer Panel Reinforcement Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3.

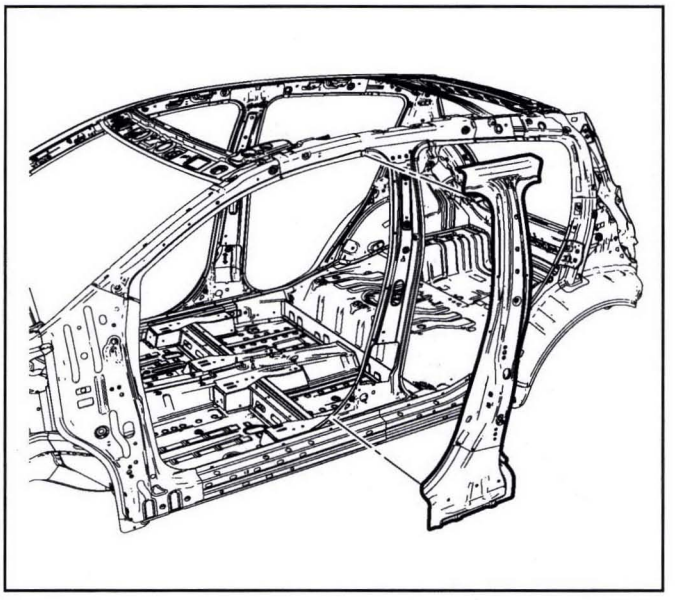
Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5.

1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.



2327450

6. Locate and mark all the necessary factory welds of the body lock pillar outer panel reinforcement.
7. Drill all factory welds. Note the number and location of welds for installation of the service assembly.

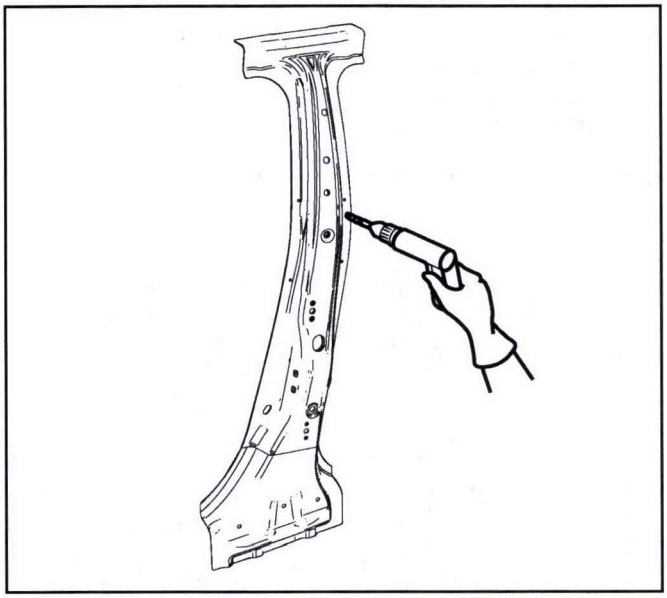


2327430

8. Remove the damaged body lock pillar outer panel reinforcement.

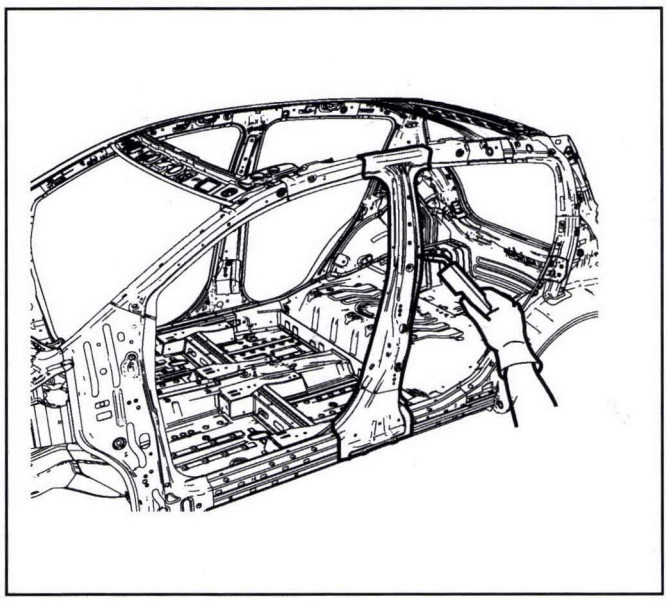
Installation Procedure

1. Prepare all mating surfaces as necessary.
2. Align the body lock pillar outer panel reinforcement.



2327427

3. Drill a 8 mm (5/16 in) for plug welding along the edges of the body lock pillar outer panel reinforcement as noted from the original panel.
4. Clean and prepare the attaching surfaces for welding.
5. Position the body lock pillar outer panel reinforcement on the vehicle.
6. Verify the fit of the body lock pillar outer panel reinforcement.
7. Clamp the body lock pillar outer panel reinforcement into position.



2327425

8. Plug the weld accordingly.
9. To create a solid weld with minimum heat distortion, make a 25 mm (1 in) stitch welds along the seam with a 25 mm (1 in) gaps between them. Then go back and complete the stitch weld.
10. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
11. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
12. Install all related panels and components.
13. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
14. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

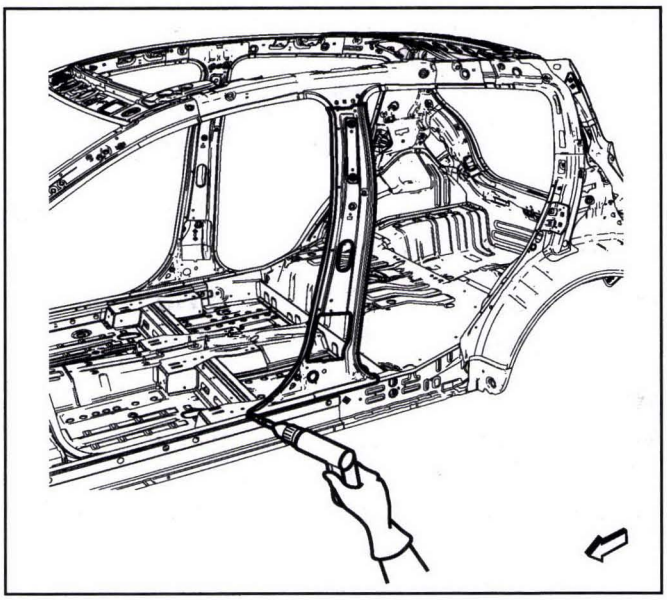
Body Lock Pillar Inner Panel Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3.

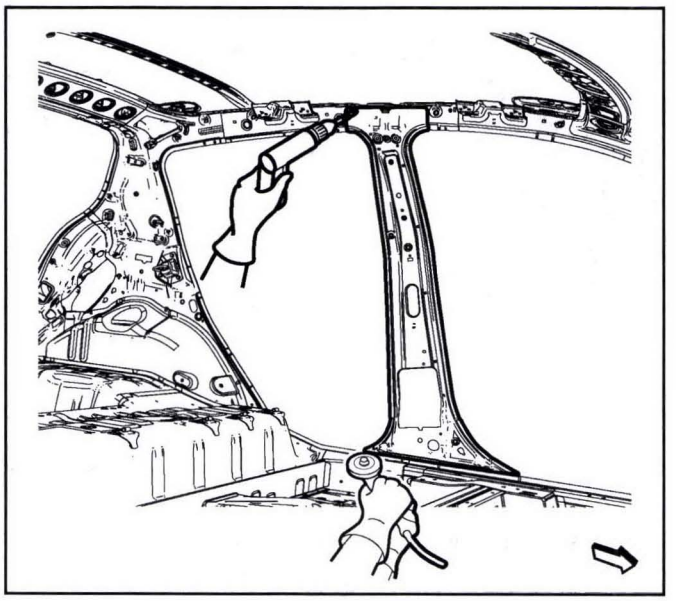
Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5.

1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
6. Locate and mark all factory welds.



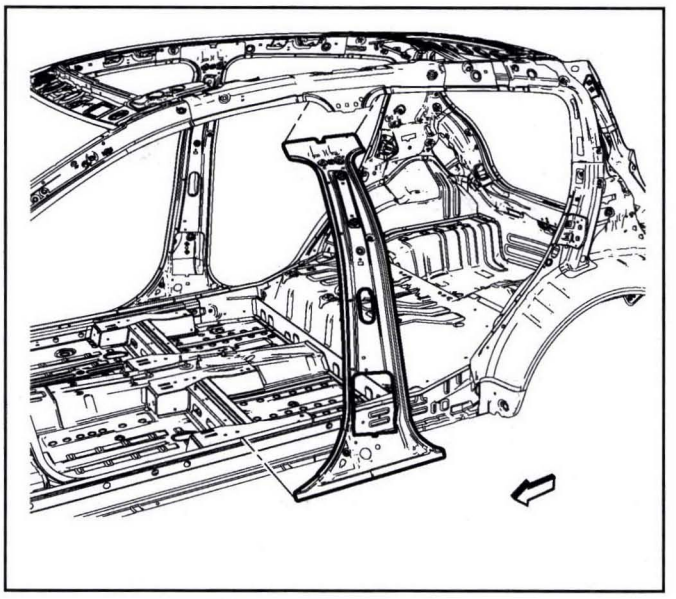
2327424

7. Drill all factory lower welds . Note the number and location of welds for installation of the service assembly.



2327421

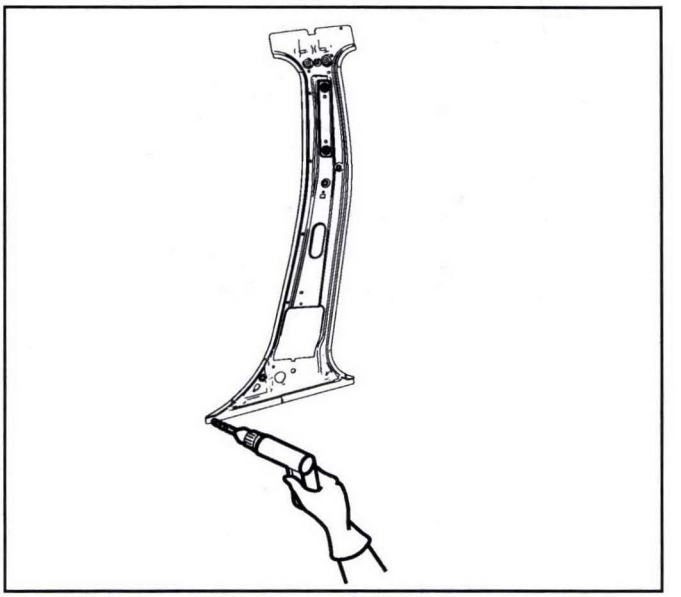
8. Drill all factory upper welds . Note the number and location of welds for installation of the service assembly.
9. Grind the factory weld seams lower.



2327419

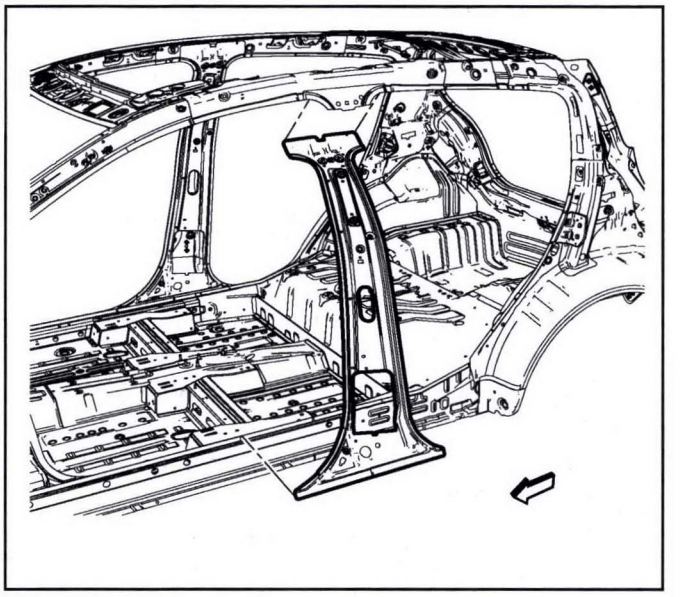
10. Remove the damaged body lock pillar inner panel.

Installation Procedure



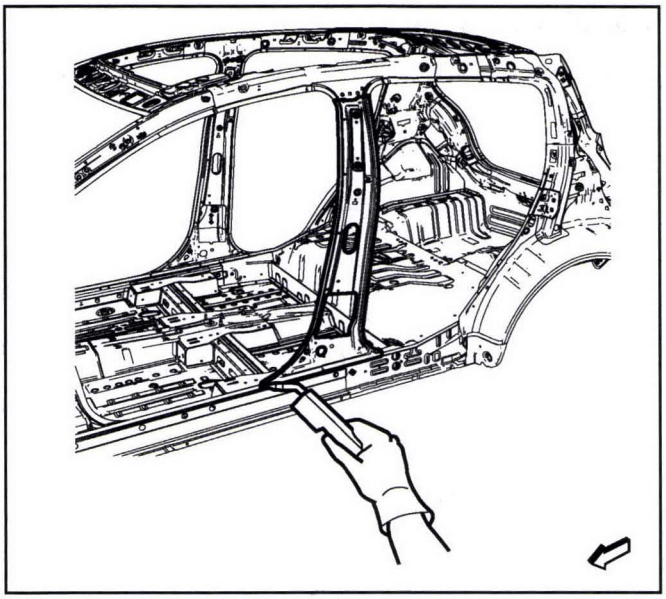
2327418

1. Drill a 8 mm (5/16 in) for plug welding along the edges of the service panel as noted from the original panel.
2. Clean and prepare the attaching surfaces for welding.



2327419

3. Position the body lock pillar inner panel on the vehicle.
4. Verify the fit of the panel.
5. Clamp the body lock pillar inner panel into position.



2327417

6. Plug the weld accordingly body lock pillar inner panel upper and lower.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
8. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
9. Install all related panels and components.
10. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
11. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

Rocker Outer Panel Sectioning

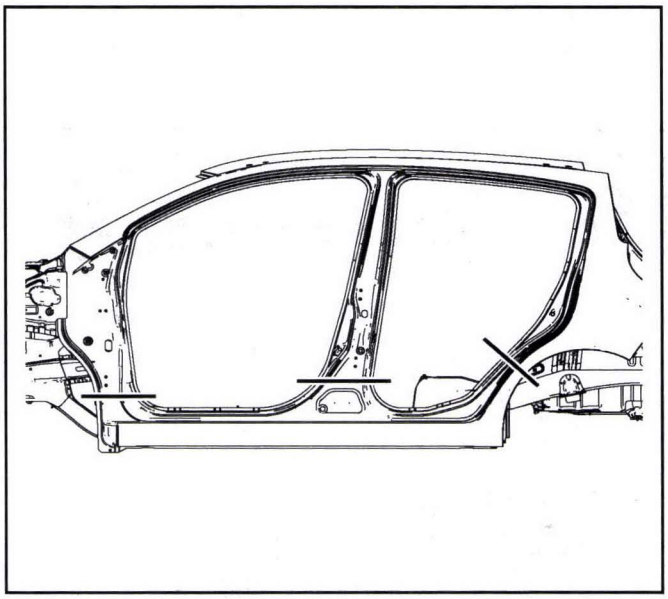
Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3.

Warning: Refer to Collision Sectioning Warning on page 0-4.

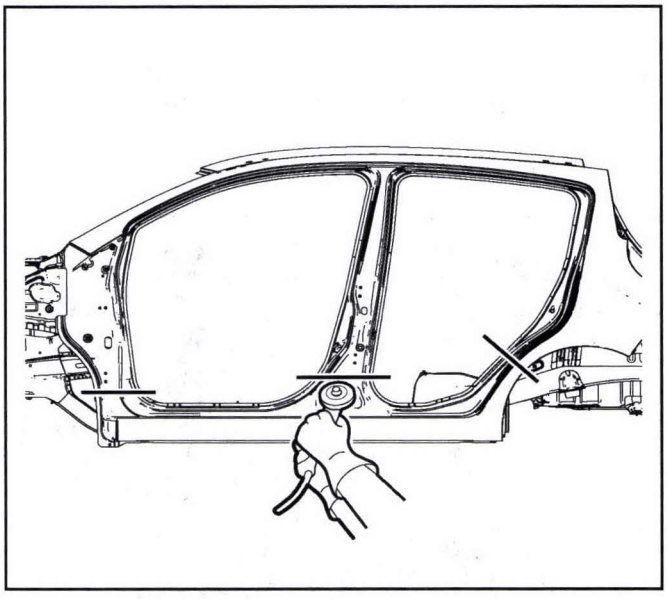
Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5.

1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.



2327416

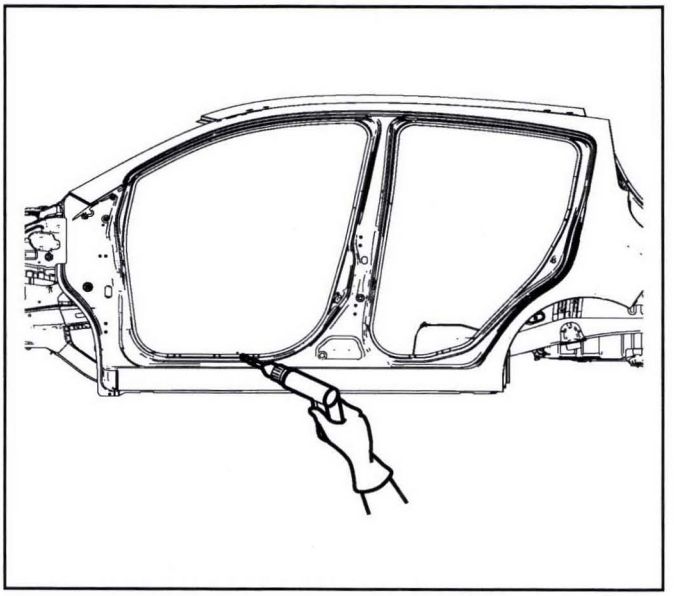
6. Create cut lines on the rocker outer panel.



2327415

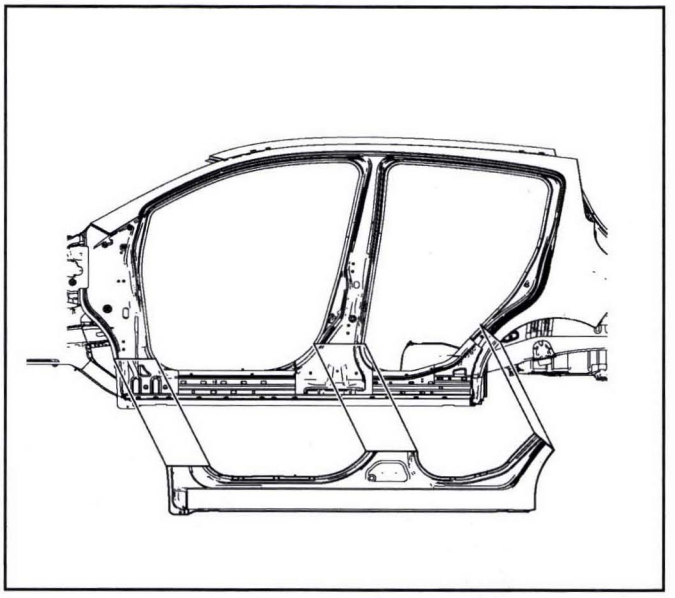
Note: Do not damage any inner panels or reinforcements.

7. Cut the panel where sectioning is to be performed.



2327414

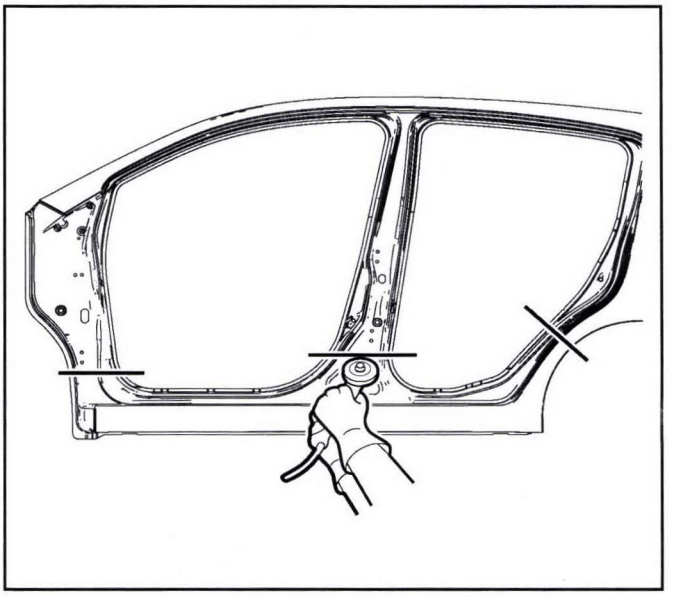
8. Locate and mark all the necessary factory welds of the rocker outer panel.
9. Drill all factory welds. Note the number and location of welds for installation of the service assembly.



2327411

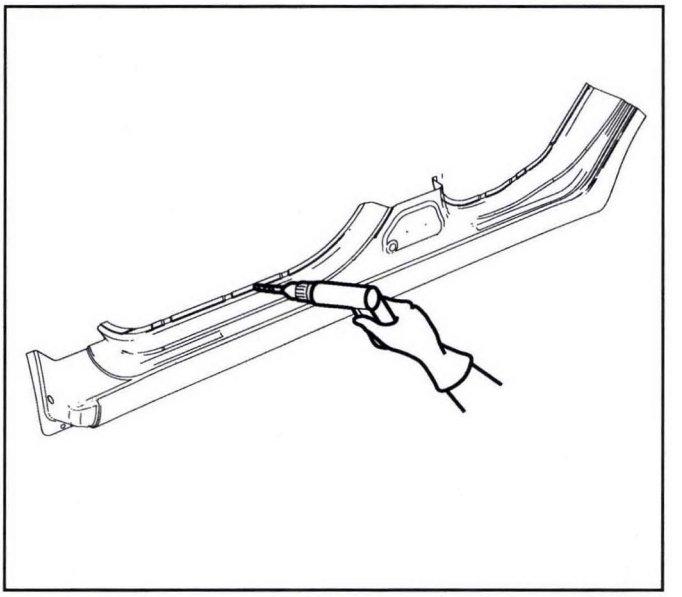
10. Remove the damaged rocker outer panel.

Installation Procedure



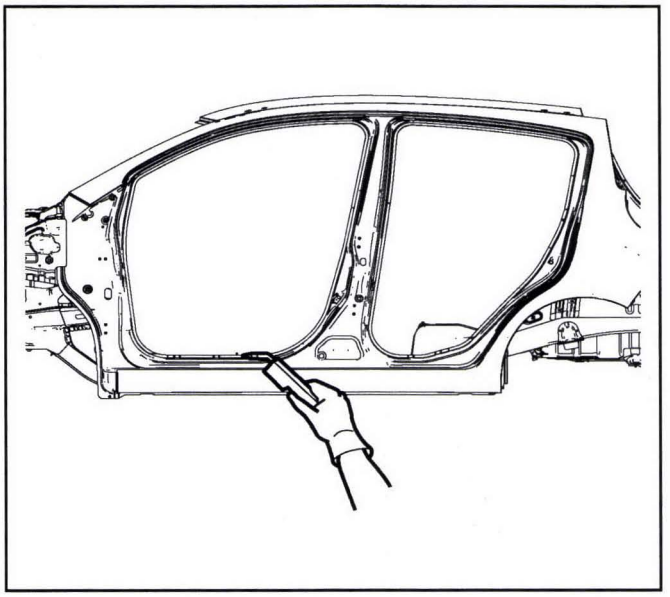
2327409

1. Cut the rocker outer panel in corresponding locations to fit the remaining original panel. The sectioning joint should be trimmed to allow a gap of one-and-one-half-times the metal thickness at the sectioning joint.
2. Create a 50 mm (2 in) backing plate from the unused portion of the service part.
3. Drill a 8 mm (5/16 in) along the sectioning cut on the remaining original part. Locate these holes 13 mm (1/2 in) from the edge of part and spaced 40 mm (1 1/2 in) apart.
4. Prepare all mating surfaces as necessary.
5. Fit the backing plates halfway into the sectioning joints, clamp in place and plug weld to the vehicle.
6. Align the rocker outer panel.



2327407

7. Drill a 8 mm (5/16 in) for plug welding along the edges of the rocker outer panel as noted from the original panel.
8. Clean and prepare the attaching surfaces for welding.
9. Position the rocker outer panel on the vehicle.
10. Verify the fit of the rocker outer panel.
11. Clamp the rocker outer panel into position.



2327403

12. Plug the weld accordingly.
13. To create a solid weld with minimum heat distortion, make a 25 mm (1 in) stitch weld along the seam with 25 mm (1 in) gaps between them. Then go back and complete the stitch weld.
14. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
15. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
16. Install all related panels and components.
17. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
18. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

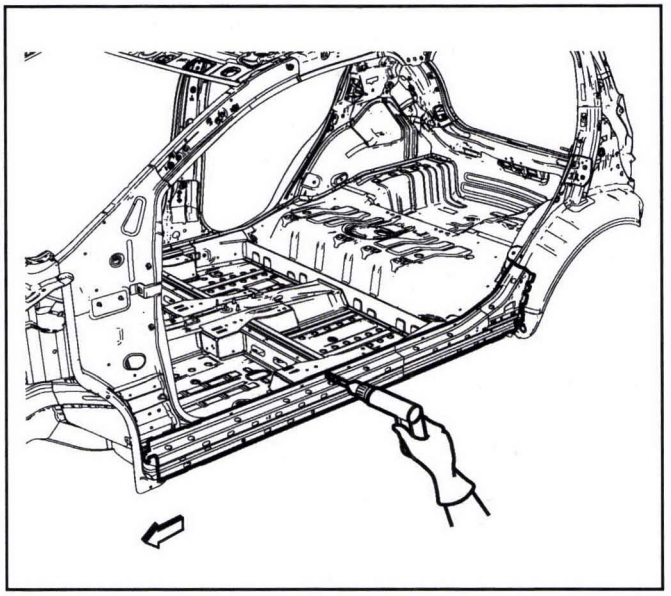
Body Side Outer Panel Reinforcement Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3.

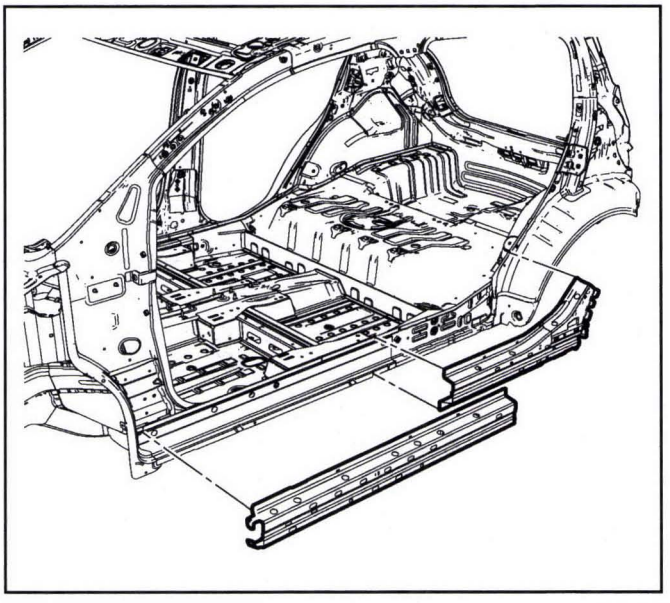
Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5.

1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.



2327402

6. Locate and mark all the necessary factory welds of the body side outer panel reinforcement.
7. Drill all factory welds. Note the number and location of welds for installation of the service assembly.

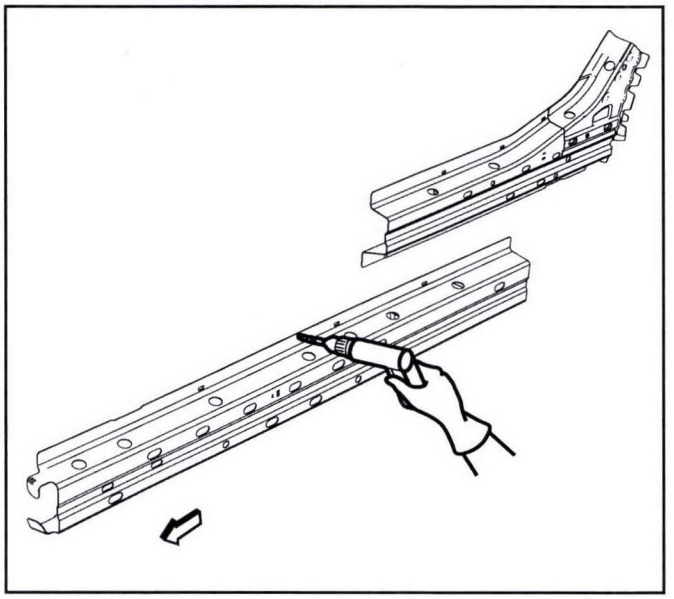


2327400

8. Remove the damaged body side outer panel reinforcement.

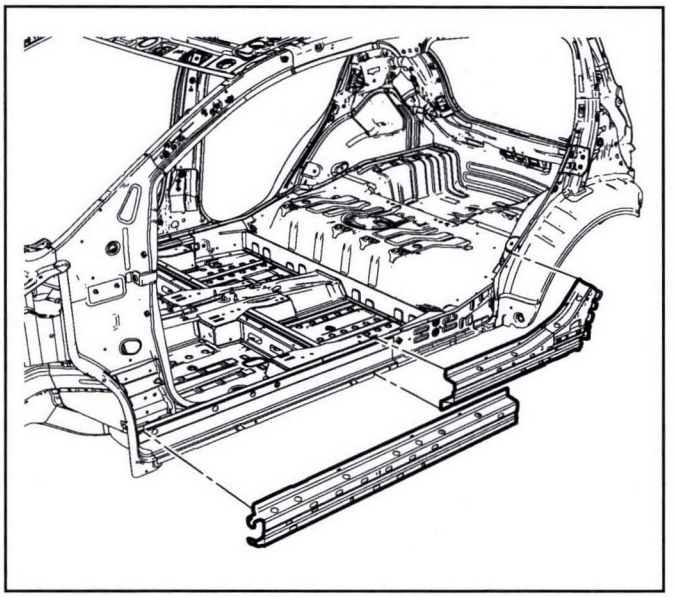
Installation Procedure

1. Align the body side outer panel reinforcement.



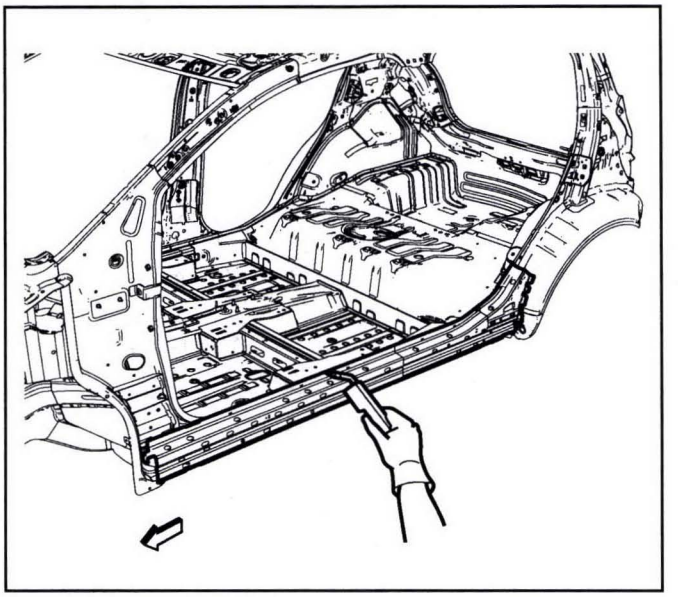
2327398

2. Drill a 8 mm (5/16 in) for plug welding along the edges of the body side outer panel reinforcement as noted from the original panel.
3. Clean and prepare the attaching surfaces for welding.



2327400

4. Position the body side outer panel reinforcement on the vehicle.
5. Verify the fit of the body side outer panel reinforcement.
6. Clamp the body side outer panel reinforcement into position.



2327396

7. Plug the weld accordingly.
8. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
9. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
10. Install all related panels and components.
11. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
12. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

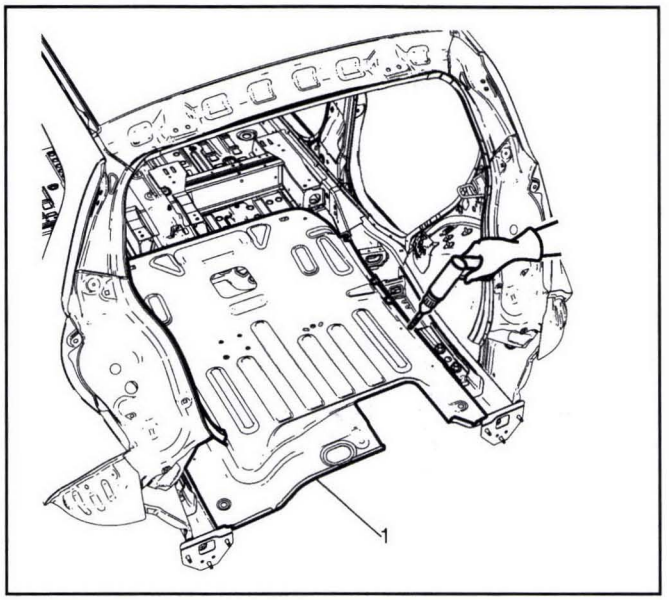
Rear Compartment Floor Panel Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3.

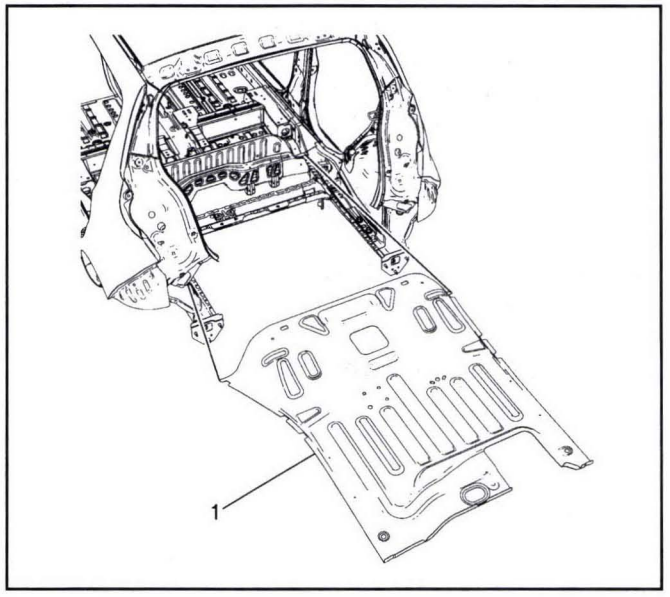
Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5.

1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.



3247932

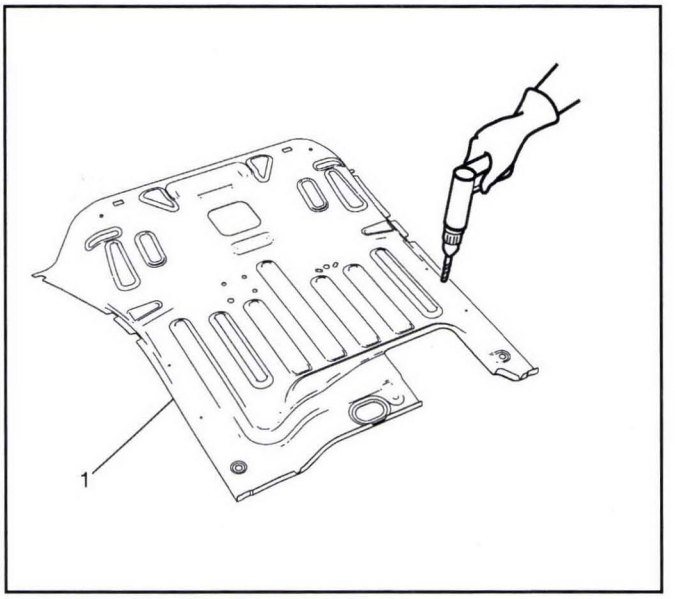
6. Locate and mark all the necessary factory welds of the rear compartment floor panel (1).
7. Drill all factory welds. Note the number and location of welds for installation of the service assembly.



3247934

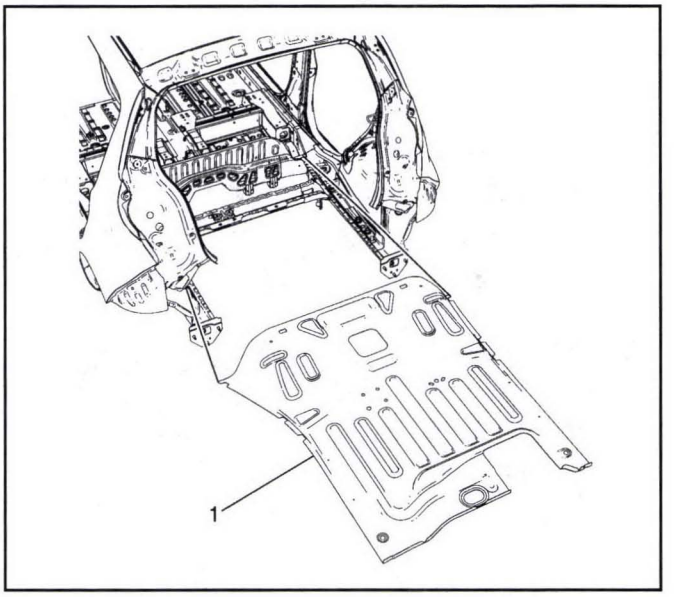
8. Remove the damaged rear compartment floor panel (1).

Installation Procedure



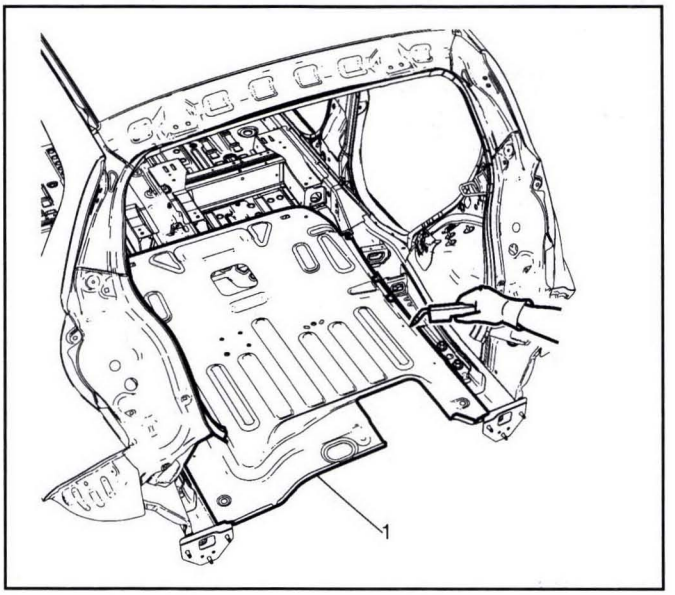
3247936

1. Drill a 8 mm (5/16 in) for plug welding along the edges of the rear compartment floor panel as noted from the original panel.
2. Clean and prepare the attaching surfaces for welding.



3247934

3. Position the rear compartment floor panel (1) on the vehicle.
4. Verify the fit of the rear compartment floor panel.
5. Clamp the rear compartment floor panel into position.



3247937

6. Plug the weld accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
8. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
9. Install all related panels and components.
10. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
11. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

Quarter Outer Panel Sectioning

Special Tools

- *BO-6392* Flanging Tool Kit
- *BO-6396* Bonding Pliers

For equivalent regional tools, refer to *Special Tools on page 3-117*.

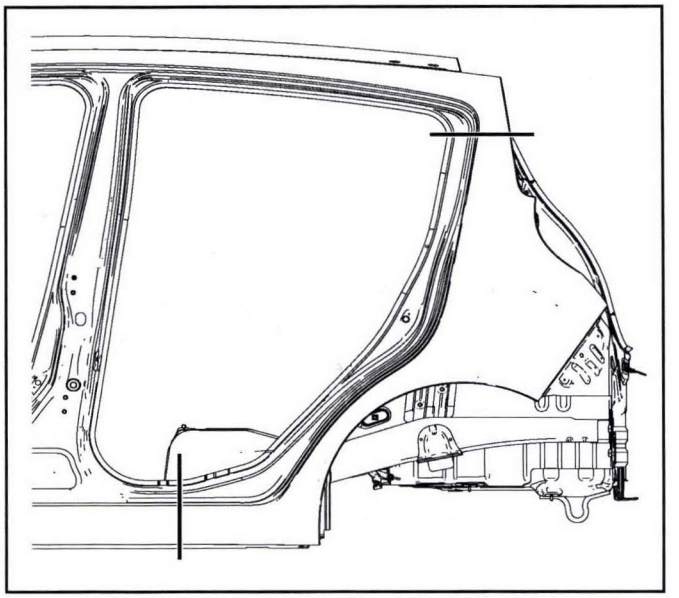
Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3.

Warning: Refer to Collision Sectioning Warning on page 0-4.

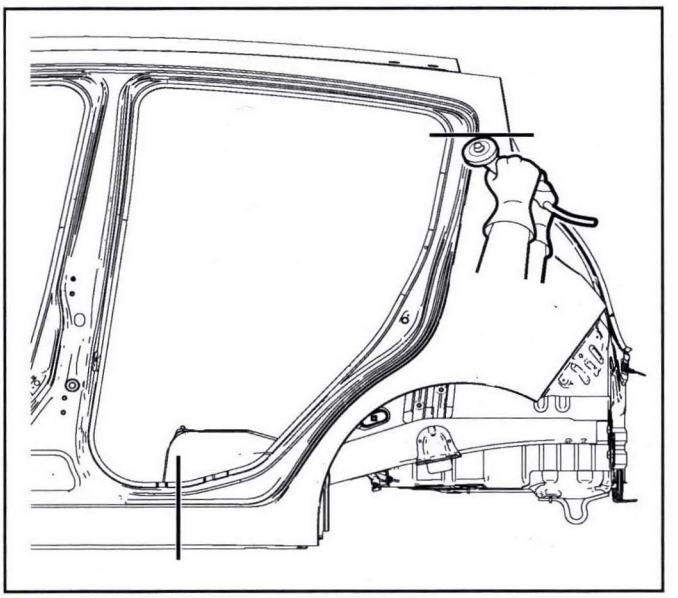
Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5.

1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.



2327332

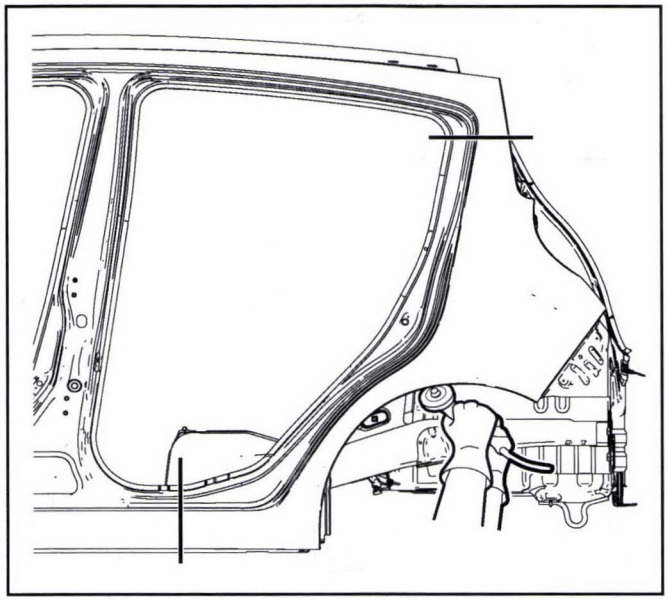
6. Create cut lines on the quarter outer panel.



2327331

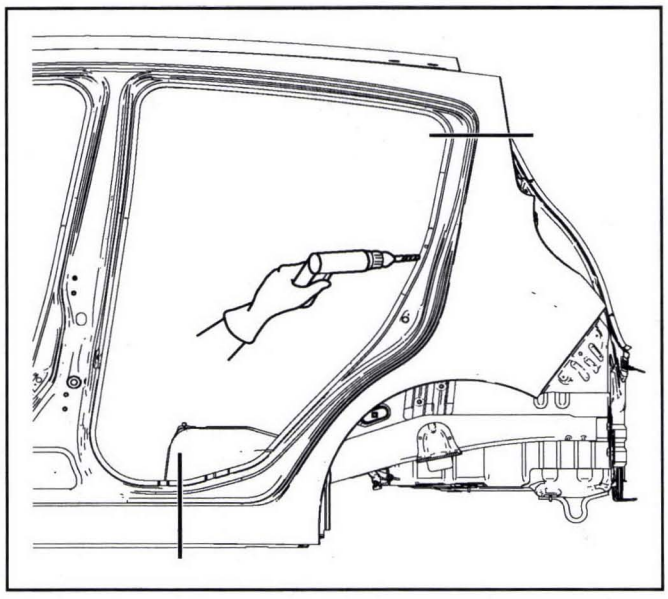
Note: Do not damage any inner panels or reinforcements.

7. Cut the panel where sectioning is to be performed.



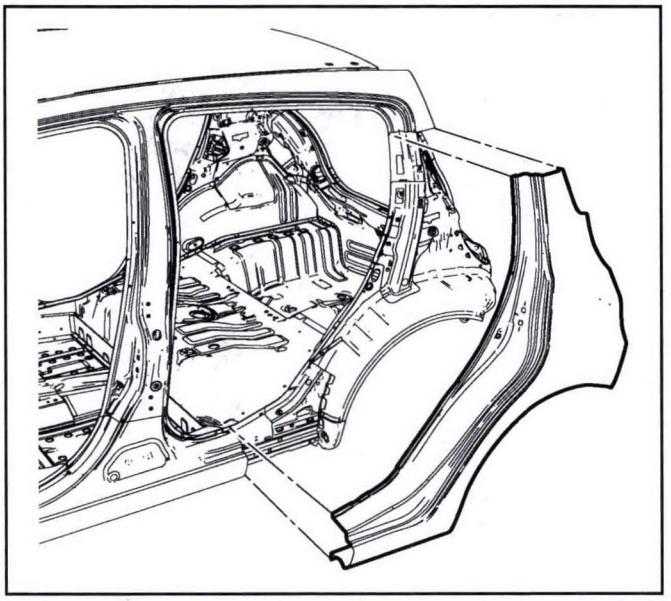
2327330

8. Open the wheelhouse flanging.



2327329

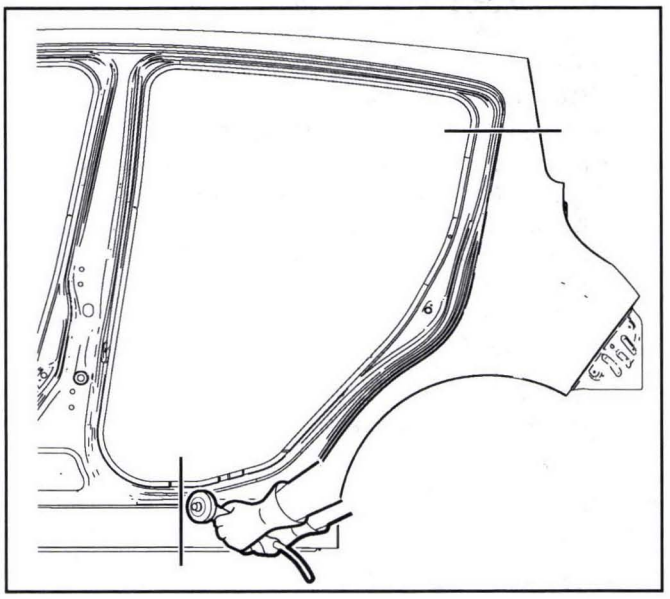
9. Locate and mark all the necessary factory welds of the quarter outer panel.
10. Drill all factory welds. Note the number and location of welds for installation of the service assembly.



2327328

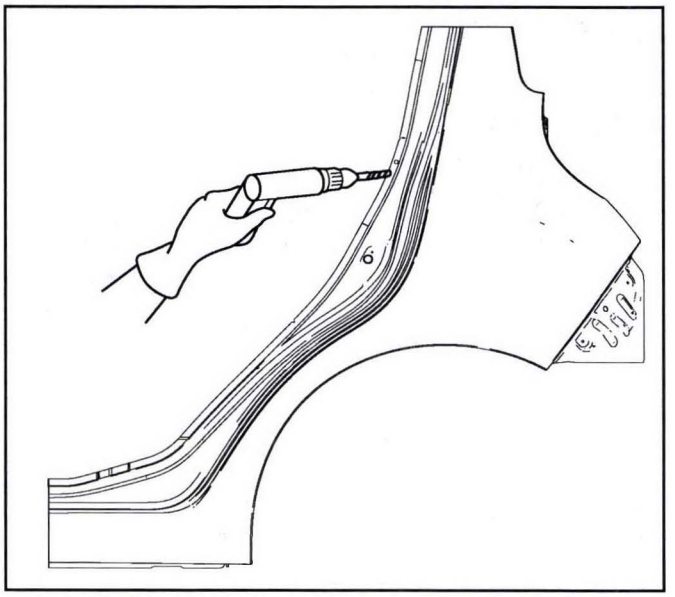
11. Remove the damaged quarter outer panel.

Installation Procedure



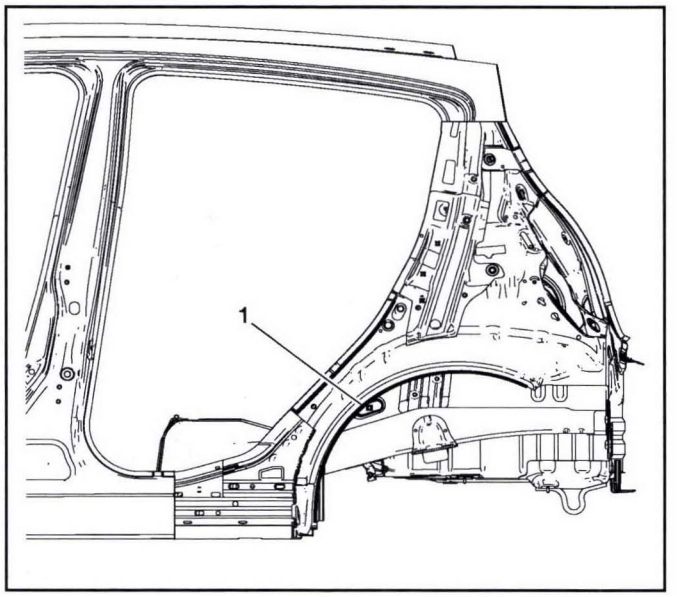
2327327

1. Cut the quarter outer panel in corresponding locations to fit the remaining original panel. The sectioning joint should be trimmed to allow a gap of one-and-one-half-times the metal thickness at the sectioning joint.
2. Create a 50 mm (2 in) backing plate from the unused portion of the service part.
3. Drill a 8 mm (5/16 in) along the sectioning cut on the remaining original part. Locate these holes 13 mm (1/2 in) from the edge of part and spaced 40 mm (1 1/2 in) apart.
4. Prepare all mating surfaces as necessary.
5. Fit the backing plates halfway into the sectioning joints, clamp in place and plug weld to the vehicle.
6. Align the quarter outer panel.



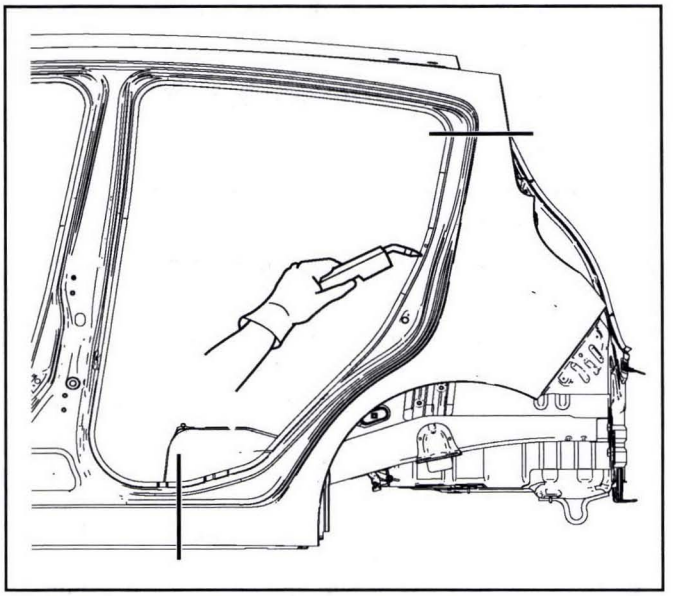
2327326

7. Drill a 8 mm (5/16 in) for plug welding along the edges of the quarter outer panel as noted from the original panel.
8. Clean and prepare the attaching surfaces for welding.



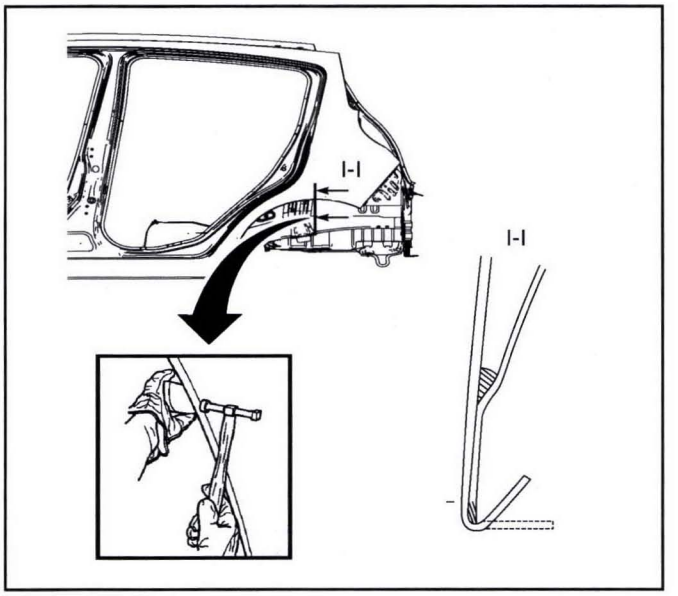
2327325

9. Apply structural adhesive (1) as noted from the original panel.
10. Position the quarter outer panel on the vehicle.
11. Verify the fit of the quarter outer panel.
12. Clamp the quarter outer panel into position.



2327324

13. Plug the weld accordingly.
14. To create a solid weld with minimum heat distortion, make 25 mm (1 in) stitch welds along the seam with 25 mm (1 in) gaps between them. Then go back and complete the stitch weld.
15. Pre-flang the flange with *BO-6396* pliers and *BO-6392* tool kit.



2327323

16. Finish closing the wheelhouse flanging.
17. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
18. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
19. Install all related panels and components.
20. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.

21. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

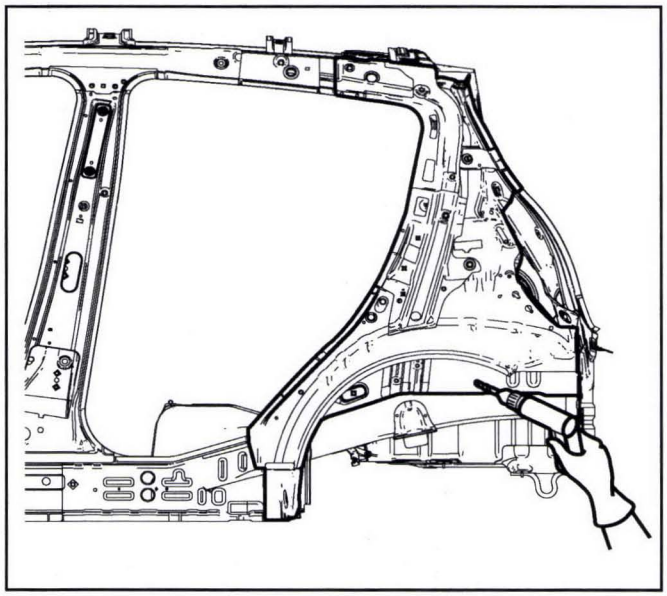
Quarter Inner Panel Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3.

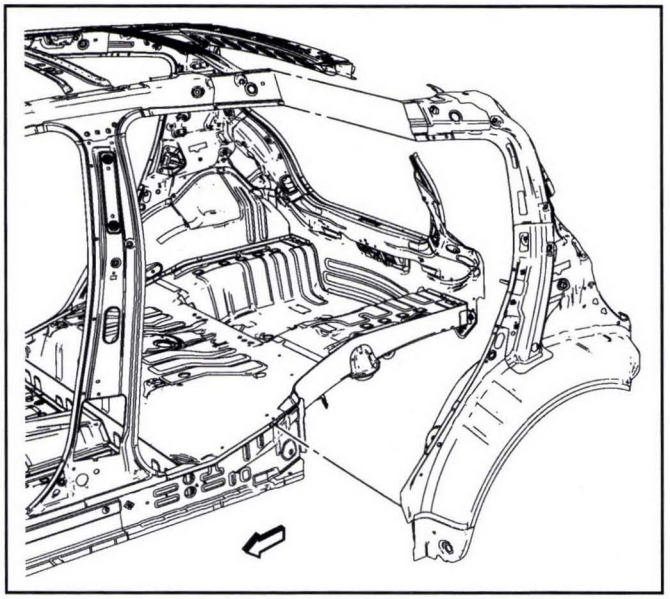
Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5.

1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.



2327395

6. Locate and mark all factory welds.
7. Drill all factory welds. Note the number and location of welds for installation of the service assembly.

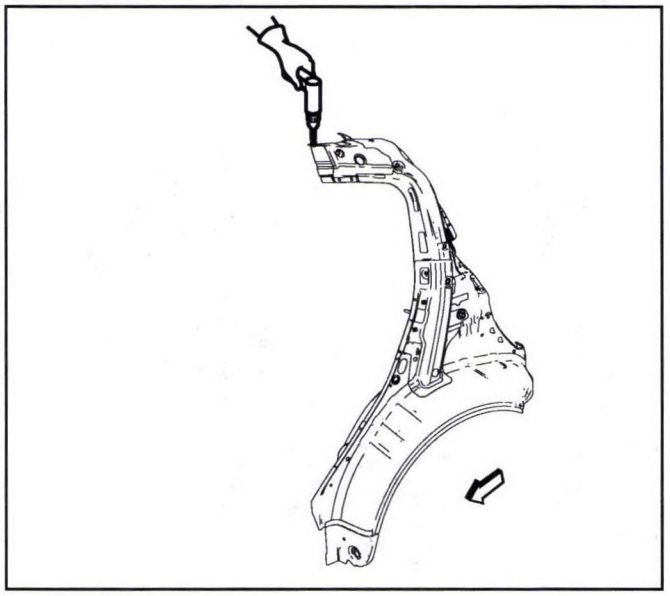


2327394

8. Remove the damaged quarter inner panel.

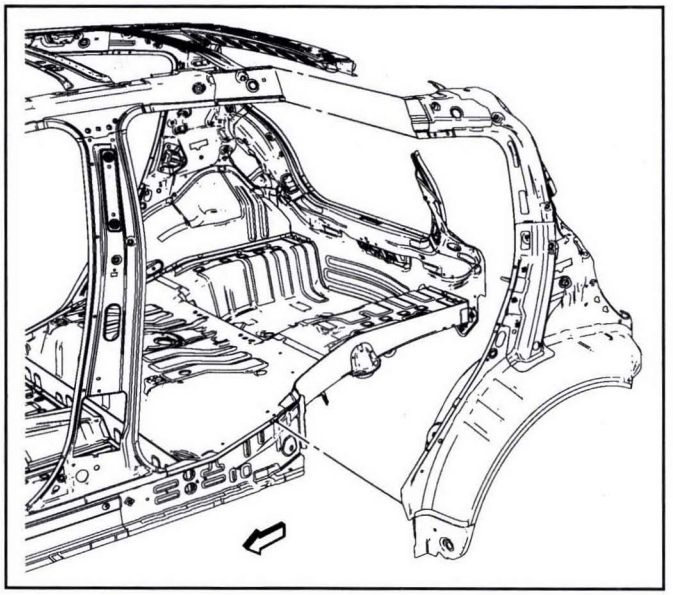
Installation Procedure

1. Align the quarter inner panel.



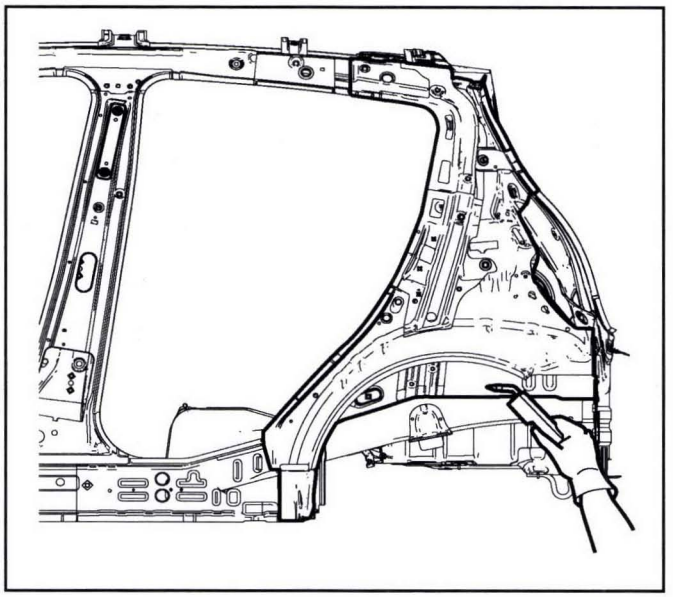
2327388

2. Drill a 8 mm (5/16 in) for plug welding along the edges of the service panel as noted from the original panel.
3. Clean and prepare the attaching surfaces for welding.



2327394

4. Position the quarter inner panel.
5. Verify the fit of the panel.
6. Clamp the panel into position.



2327337

7. Plug weld accordingly.
8. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
9. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
10. Install all related panels and components.
11. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
12. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

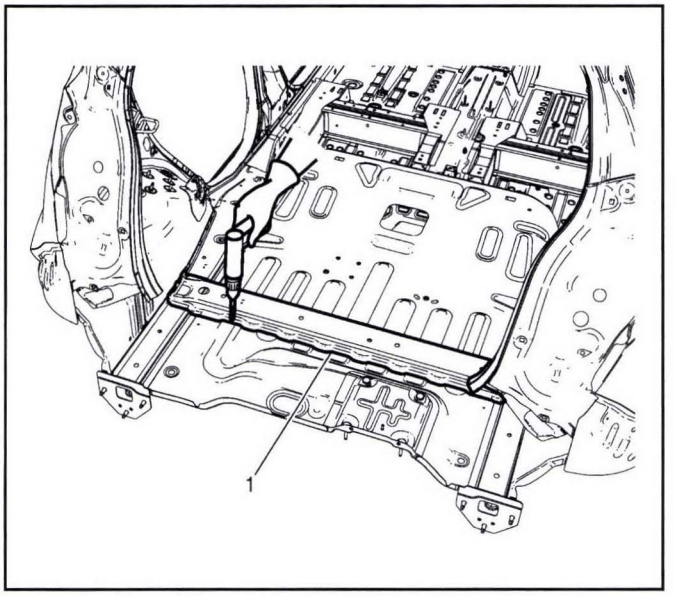
Floor Panel Number 6 Cross Bar Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3.

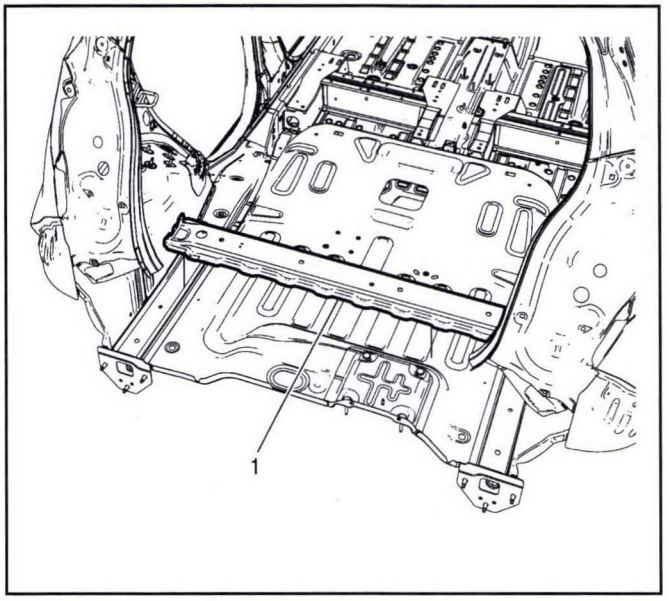
Note: The floor panel number 6 cross bar is made of Ultra High Strength Steel and should be replaced only at factory joints. Repairing or sectioning of this part is not recommended. Refer to *Ultra High Strength Steel on page 3-116*.

1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all related panels and components.
4. Repair as much of the damage as possible to factory specifications. Refer to *Dimensions - Body on page 3-68*.
5. Remove the sealers and anti-corrosion materials from the repair area. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
6. Locate and mark all factory welds.



3247911

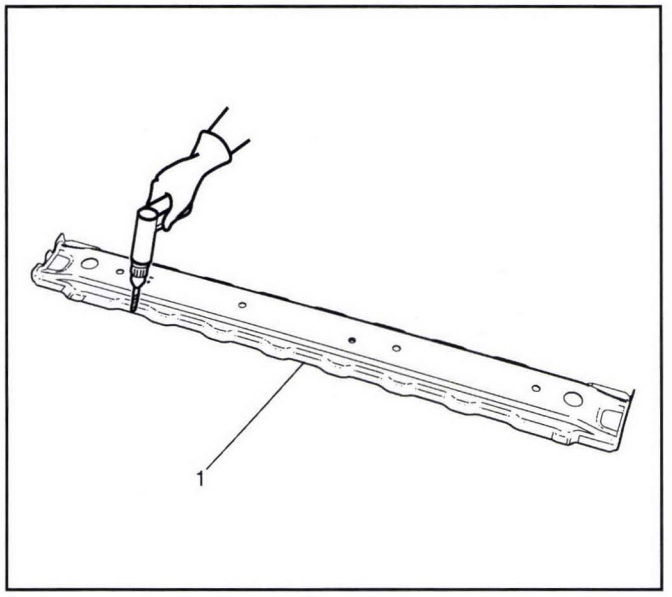
7. Drill all factory welds (1). Note the number and location of welds for installation of the service assembly.



3247913

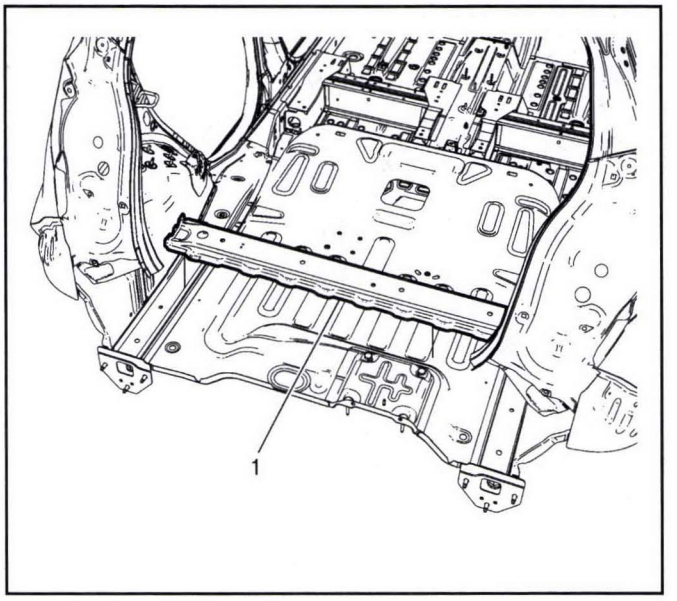
8. Remove the damaged floor panel number 6 cross bar (1).

Installation Procedure



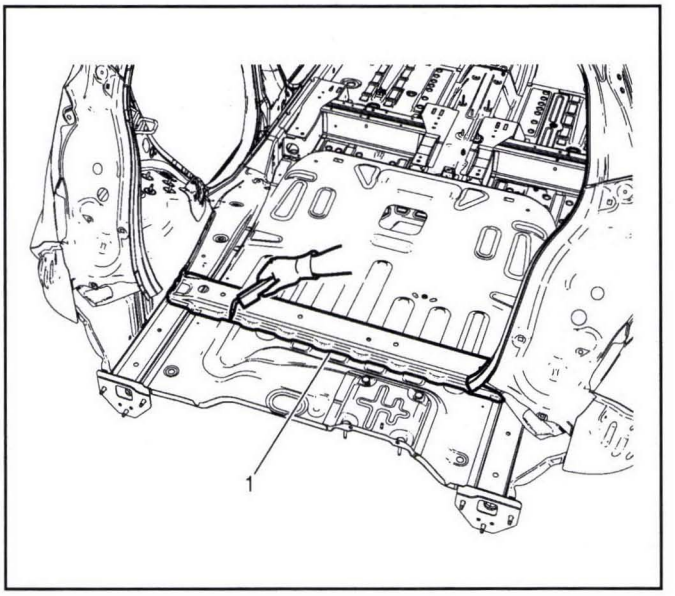
3247915

1. Drill **8 mm (5/16 in)** holes for plug welding along the edges of the service panel as noted from the original panel (1).
2. Clean and prepare the attaching surfaces for welding.



3247913

3. Position the floor panel number 6 cross bar (1) panel on the vehicle.
4. Verify the fit of the panel.
5. Clamp the floor panel number 6 cross bar into position.



3247917

6. Plug weld accordingly (1).
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
8. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
9. Install all related panels and components.
10. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
11. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

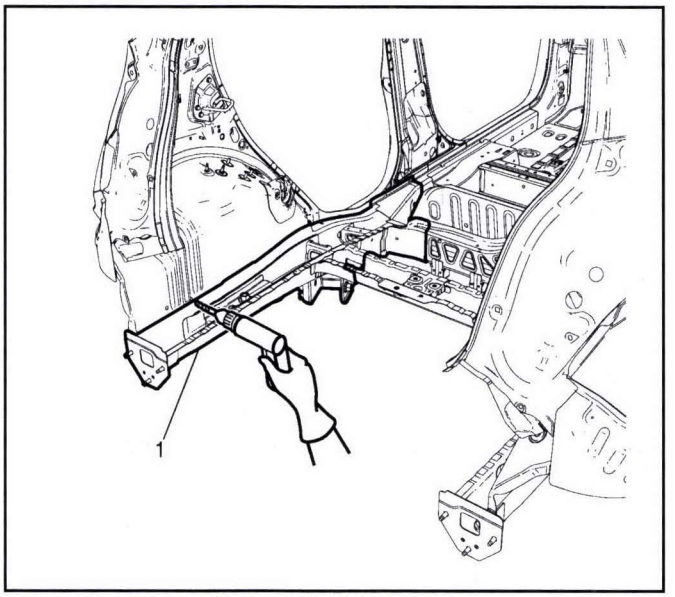
Underbody Rear Side Rail Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3.

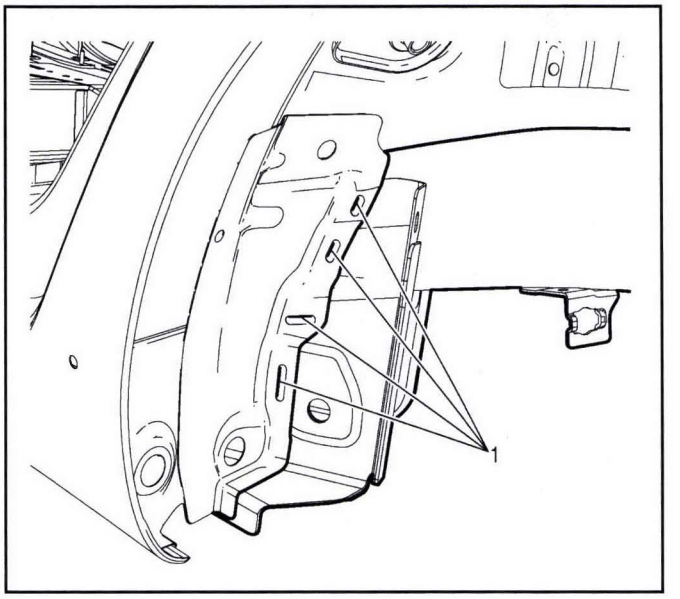
Note: The underbody rear side rail is made of Ultra High Strength Steel and should be replaced only at factory joints. Repairing or sectioning of this part is not recommended. Refer to *Ultra High Strength Steel on page 3-116*.

1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all related panels and components.
4. Repair as much of the damage as possible to factory specifications. Refer to *Dimensions - Body on page 3-68*.
5. Remove the sealers and anti-corrosion materials from the repair area. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
6. Locate and mark all factory welds.



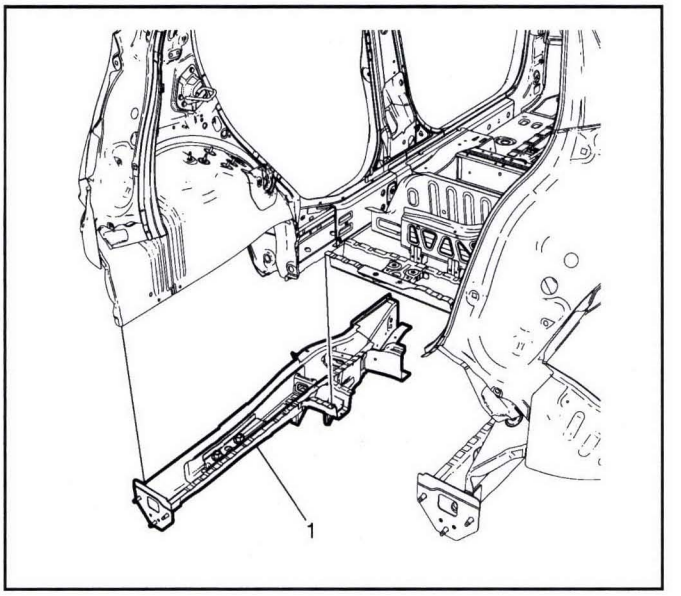
3247940

7. Drill all factory welds (1). Note the number and location of welds for installation of the service assembly.



3247941

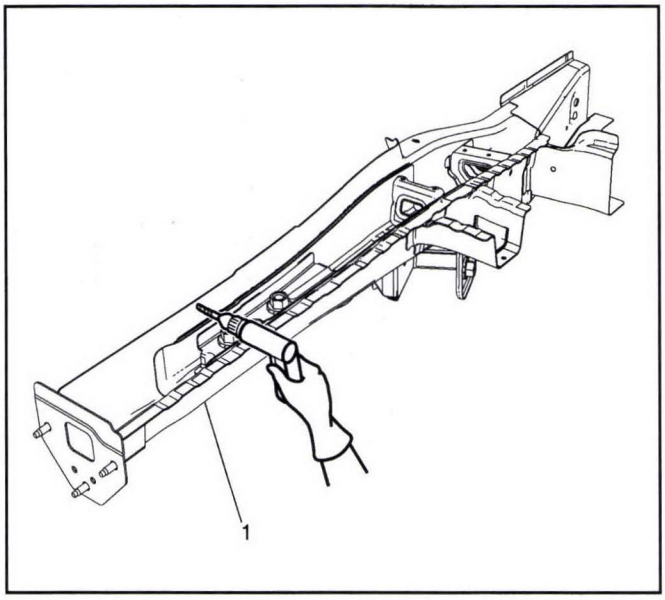
8. Grind factory weld seams (1).



3247943

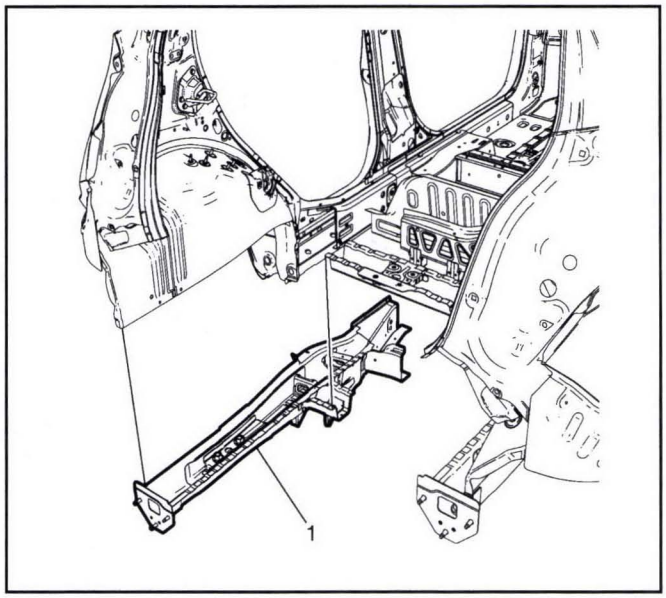
9. Remove the damaged underbody rear side rail (1).

Installation Procedure



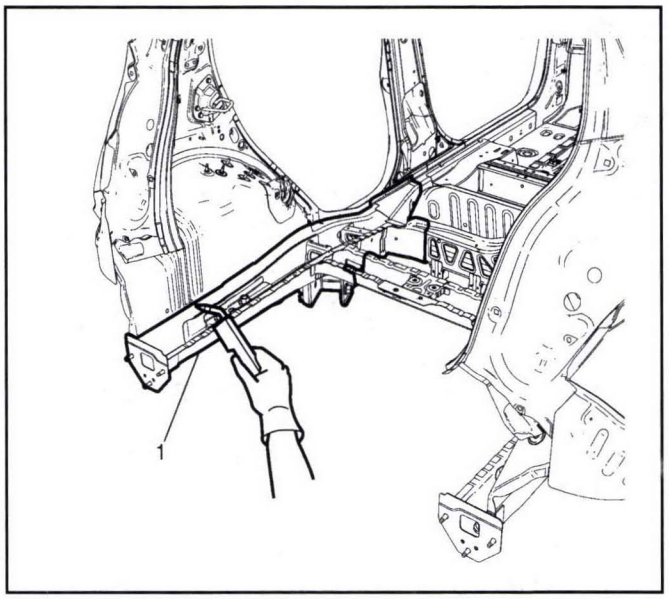
3247945

1. Drill **8 mm (5/16 in)** holes for plug welding along the edges of the service panel as noted from the original panel (1).
2. Clean and prepare the attaching surfaces for welding.



3247943

3. Position the underbody rear side rail (1) panel on the vehicle.
4. Verify the fit of the panel.
5. Clamp the underbody rear side rail into position.



3247947

6. Plug weld accordingly (1).
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
8. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
9. Install all related panels and components.
10. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
11. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

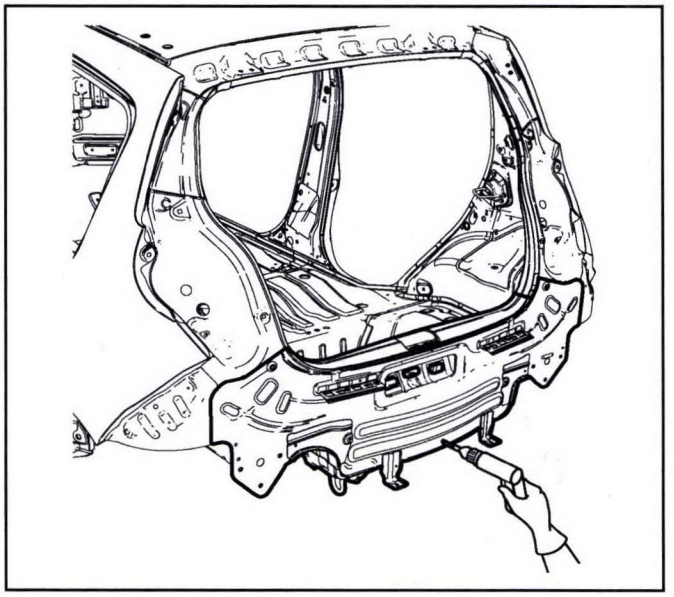
Rear End Panel Replacement

Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3.

Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5.

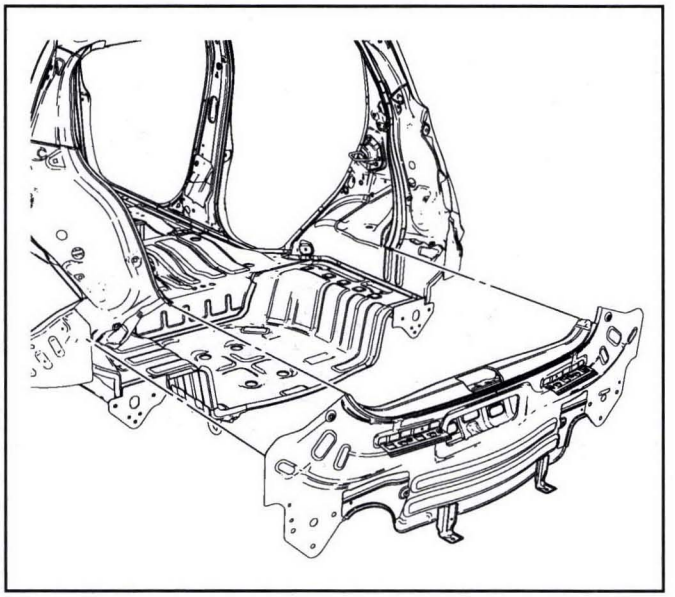
1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.



2327312

Note: Note the number and location of welds for installation of the service assembly.

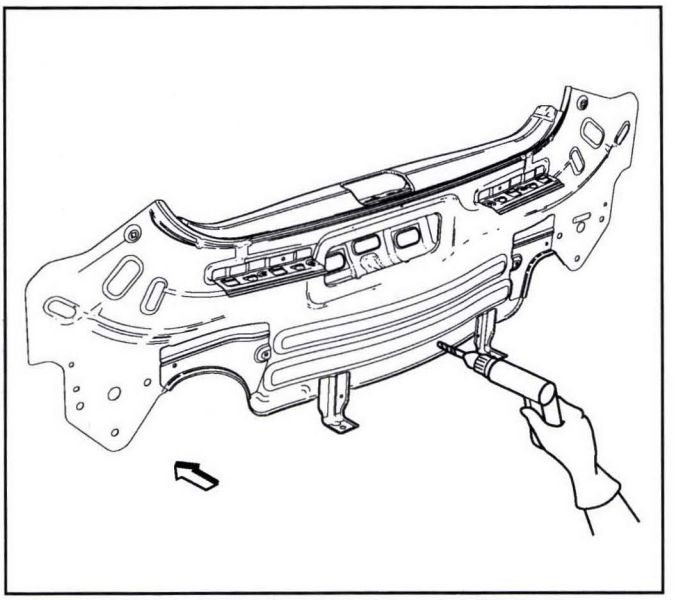
6. Locate and mark all the necessary factory welds of the body rear end panel.
7. Drill all factory welds.



2327310

8. Remove the body rear end panel.

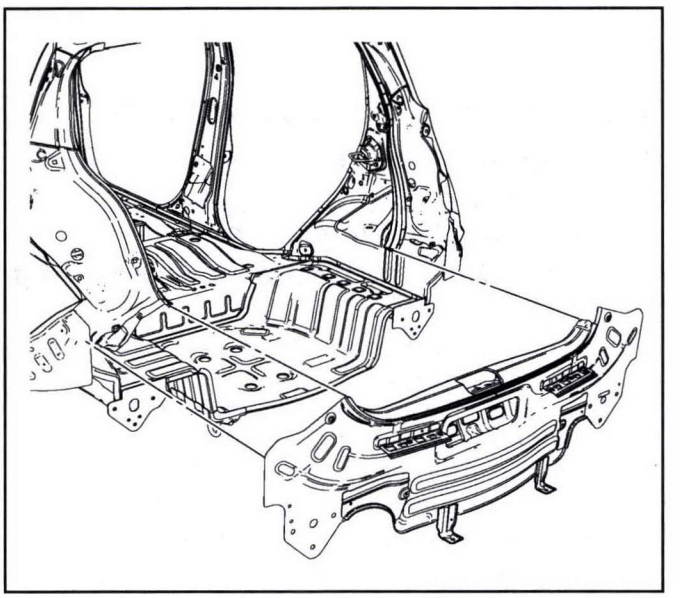
Installation Procedure



2327309

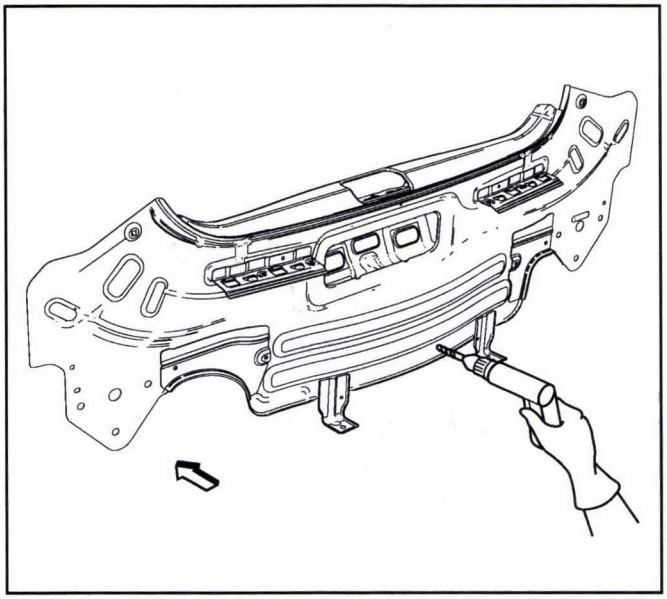
Note: If the location of the original plug weld holes can not be determined, space the plug weld holes every 40 mm (1 1/2 in).

1. Drill 8 mm (5/16 in) for plug welding along the edges of the body rear end panel as noted from the original panel.
2. Clean and prepare the attaching surfaces for welding.

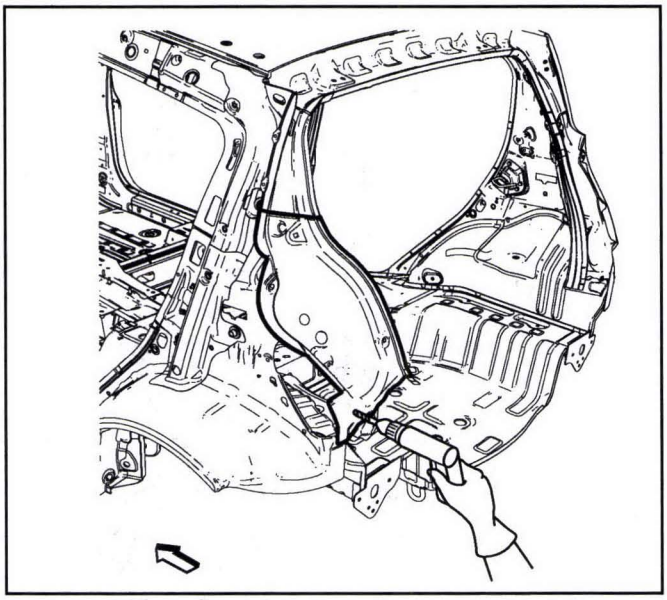


2327310

3. Position the body rear end panel on the vehicle.
4. Verify the fit of the body rear end panel.
5. Clamp the body rear end panel into position.



2327309



2327306

6. Plug the weld accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
8. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
9. Install all related panels and components.
10. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
11. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

Tail Lamp Pocket Replacement

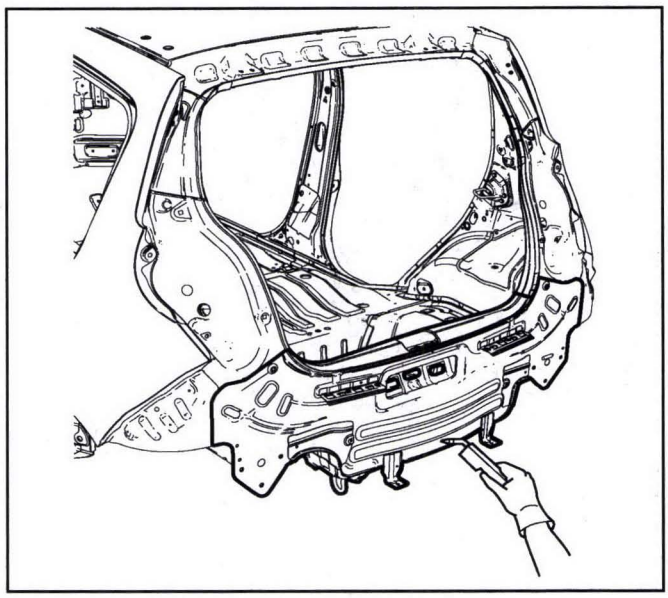
Removal Procedure

Warning: Refer to Approved Equipment for Collision Repair Warning on page 0-3.

Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5.

1. Disable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.
2. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
6. Locate and mark all factory welds.
7. Locate and mark all the necessary factory welds of the body rear end panel.

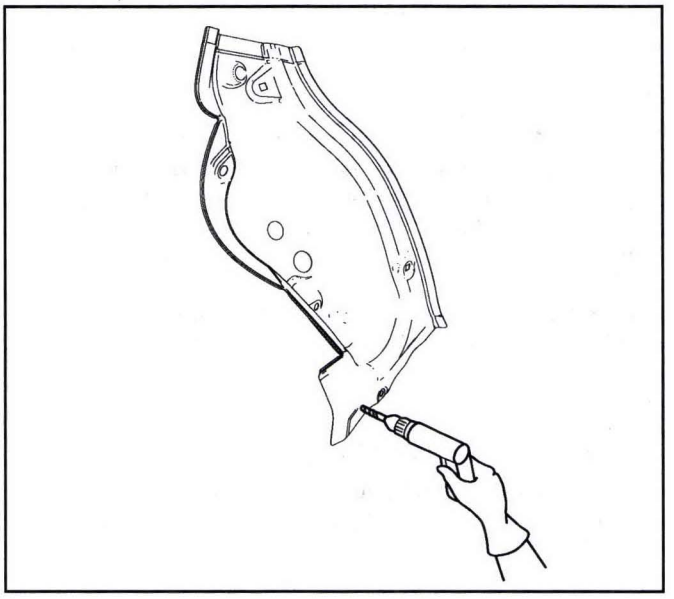
   Note: Note the number and location of welds for installation of the service assembly.
8. Drill all factory welds.



2327307

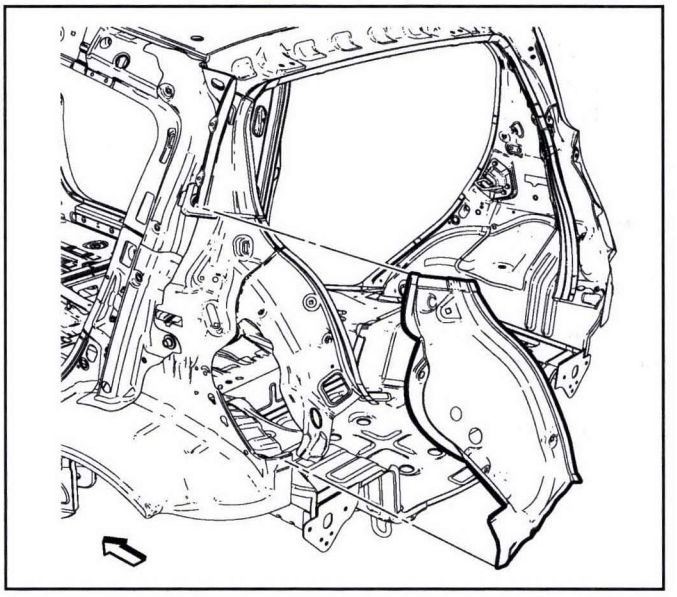
9. Remove the tail lamp pocket.

Installation Procedure



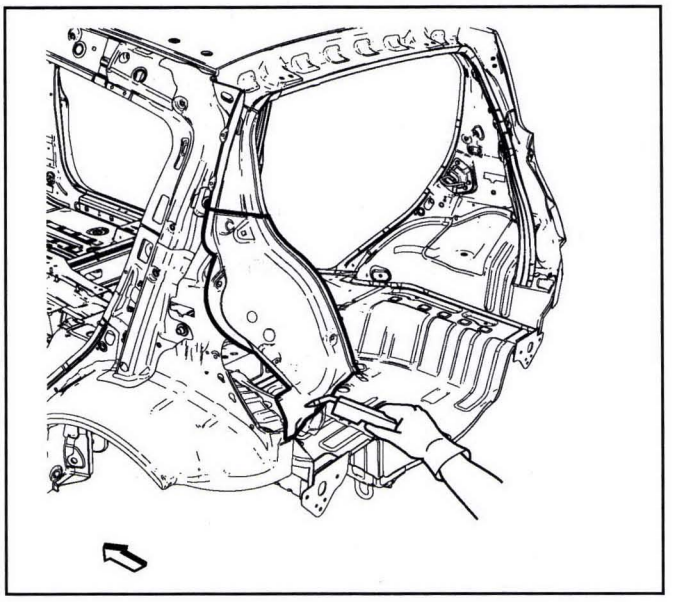
2327303

1. Drill 8 mm (5/16 in) for plug welding along the edges of the tail lamp pocket as noted from the original panel.
2. Clean and prepare the attaching surfaces for welding.



2327305

3. Position the tail lamp pocket on the vehicle.
4. Verify the fit of the tail lamp pocket.
5. Clamp the tail lamp pocket into position.



2327302

6. Plug the weld accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to *Anti-Corrosion Treatment and Repair on page 3-141*.
8. Paint the repaired area. Refer to *Basecoat/ Clearcoat Paint Systems on page 3-141*.
9. Install all related panels and components.
10. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-20*.
11. Enable the SIR system. Refer to *SIR Disabling and Enabling on page 12-151*.

Description and Operation

Dual Phase Steel

This information provides repair recommendations and general guidelines for steel classified as Dual Phase Steel (dual phase steel with a tensile strength up to and including 800 MPa), also known as DP.

General Motors recommends the following when repairing or replacing this type of steel during collision repair.

Note: The use of heat to repair damage is not recommended for this classification of steel.

Recommended Repairs

- Cold repairs can be performed on this type of steel, unless the damage includes kinks. If the damage includes kinks, the part should be replaced.
- Sectioning or partial replacement of this type of steel is recommended only at approved locations, in a specific sectioning procedure.
- This type of steel can be used as a sleeve, or backer plate, when recommended in a specific sectioning procedure.
- Squeeze resistance spot welding can be used to replace factory spot welds, where applicable.

- MIG plug welding and MIG stitch welding can be used on this type of steel.
- MIG brazing can be used on this type of steel.

High Strength Low Alloy Steel

This information provides repair recommendations and general guidelines for steel classified as High Strength Low Alloy Steel, also known as HSLA. This type of steel normally has a tensile strength range from 300–700 MPa.

General Motors recommends the following when repairing or replacing this type of steel during collision repair.

Recommended Repairs

- Cold repairs can be performed on this type of steel, unless the damage includes kinks. If the damage includes kinks, the part should be replaced.
- Controlled use of heat can be used to repair damage, if the heat does not exceed 650° C (1200° F). The heat should be applied a maximum of 2 times, for up to 90 seconds.
- Sectioning or partial replacement of this type of steel is recommended only at approved locations, in a specific sectioning procedure.
- This type of steel can be used as a sleeve, or backer plate, during sectioning procedures.
- Squeeze resistance spot welding can be used to replace factory spot welds, where applicable.
- MIG plug welding and MIG stitch welding can be used on this type of steel.
- MIG brazing can be used on this type of steel.

Mild Steel

This information provides repair recommendations and general guidelines for steel classified as Mild Steel. This type of steel normally has a tensile strength less than 270 MPa. This includes the common steel names of:

- Mild Steel
- Bake Hardenable Steel (BH)
- Solid Solution Strengthened Steel

General Motors recommends the following when repairing or replacing this type of steel during collision repair.

Recommended Repairs

- Cold repairs can be performed on this type of steel, unless the damage includes kinks. If the damage includes kinks, the part should be replaced.
- Controlled use of heat can be used to repair damage, if the heat does not exceed 650° C (1200° F). The heat should be applied a maximum of 2 times, for up to 90 seconds.
- Sectioning or partial replacement of this type of steel is recommended only at approved locations, in a specific sectioning procedure.
- This type of steel can be used as a sleeve, or backer plate, when recommended in a specific sectioning procedure.
- Squeeze resistance spot welding can be used to replace factory spot welds, where applicable
- MIG plug welding and MIG stitch welding can be used on this type of steel.
- MIG brazing can be used on this type of steel.

Ultra High Strength Dual Phase Steel

This information provides repair recommendations and general guidelines for steel classified as Ultra High Strength Dual Phase Steel (dual phase steel with a tensile strength greater than 800 MPa), also known as DPX.

General Motors recommends the following when repairing or replacing this type of steel during collision repair.

Note:

- Repair of this type of steel is not recommended.
- This type of steel should be replaced at factory joints only. Sectioning or partial replacement is not recommended.
- The use of heat to repair damage is not recommended for this type of steel.
- Stitch welding is not recommended for this type of steel.
- This classification of steel cannot be used as a backing reinforcement or a sleeve for a sectioning joint, unless a specific procedure is available.

Recommended Repairs

- Squeeze resistance spot welding can be used to replace factory spot welds, where applicable.
- MIG plug welding can be used to replace factory spot welds.
- MIG brazing can be used to replace factory spot welds.

Ultra High Strength Steel

This information provides repair recommendations and general guidelines for steel classified as Ultra High Strength Steel, also know as UHSS. This type of steel normally has a tensile strength greater than 700 MPa.

This includes the common steel names of:

- Ultra High Strength Steel (UHSS)
- Martensitic Steel (MS)
- Press Hardened Steel (PHS)
- Boron Steel

Note:

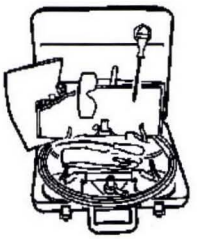
- Repair of this type of steel is not recommended.
- This type of steel should be replaced at factory joints only. Sectioning or partial replacement is not recommended.
- The use of heat to repair damage is not recommended for this type of steel.
- Stitch welding is not recommended for this type of steel.
- This type of steel can not be used as a backing reinforcement or a sleeve for a sectioning joint.

Recommended Repairs

- Squeeze resistance spot welding can be used to replace factory spot welds, where applicable.
- MIG plug welding can be used to replace factory spot welds.
- MIG brazing can be used to replace factory spot welds.

Special Tools and Equipment

Illustration	Tool Number/ Description
2019555	BO-6392 MKM-6392 Flanging Tool Kit

Illustration	Tool Number/ Description
2019554	BO-6396 KM-6396 Bonding Pliers
 2019566	BO-642-A MKM-642-A Telescope Measuring Instrument

Frame and Underbody

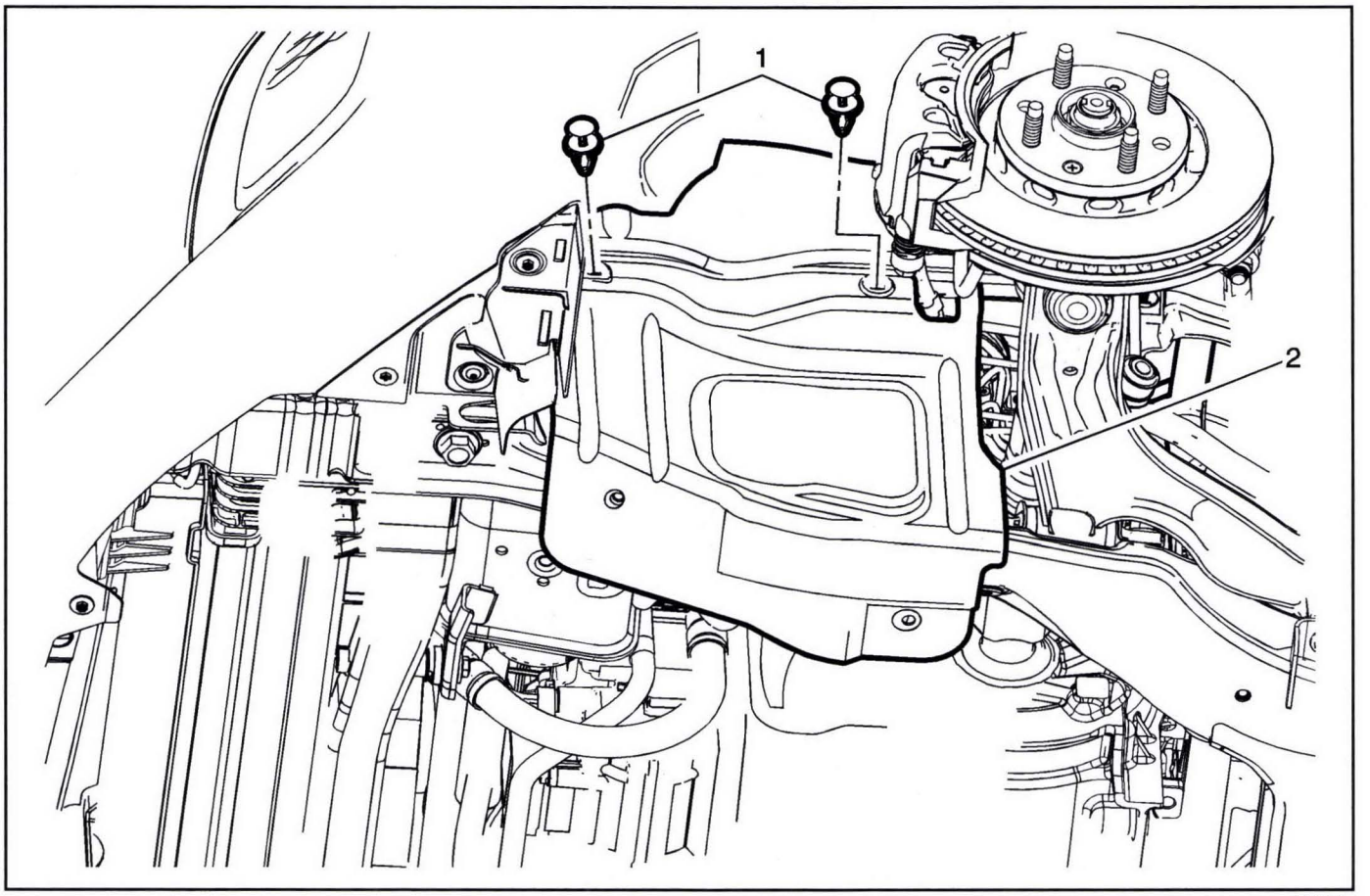
Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Drivetrain and Front Suspension Frame Bolt Center	135 N•m	100 lb ft
Drivetrain and Front Suspension Frame Bolt Front	58 N•m	43 lb ft
Drivetrain and Front Suspension Frame Bolt Rear	135 N•m	100 lb ft
Front Compartment Front Insulator Cover Bolts	22 N•m	16 lb ft
Front Compartment Front Insulator Cover Screws – Europe Only	2.5 N•m	22 lb in
Front Wheelhouse Liner Screw – Front	1.5 N•m	13 lb in
Load Floor Panel Assembly Bolt	185 N•m	136 lb ft
Power Steering Fluid Cooling Pipe Bolt, if equipped	9 N•m	80 lb in
Power Steering Inlet and Outlet Hose Bolt, if equipped	9 N•m	80 lb in
Rear Wheelhouse Panel Liner Screw	2.5 N•m	22 lb in
Skid Plate Fasteners	22 N•m	16 lb ft
Transmission Rear Mount Bracket Bolts	100 N•m	74 lb ft

Repair Instructions

Front Compartment Splash Shield Replacement (Front)

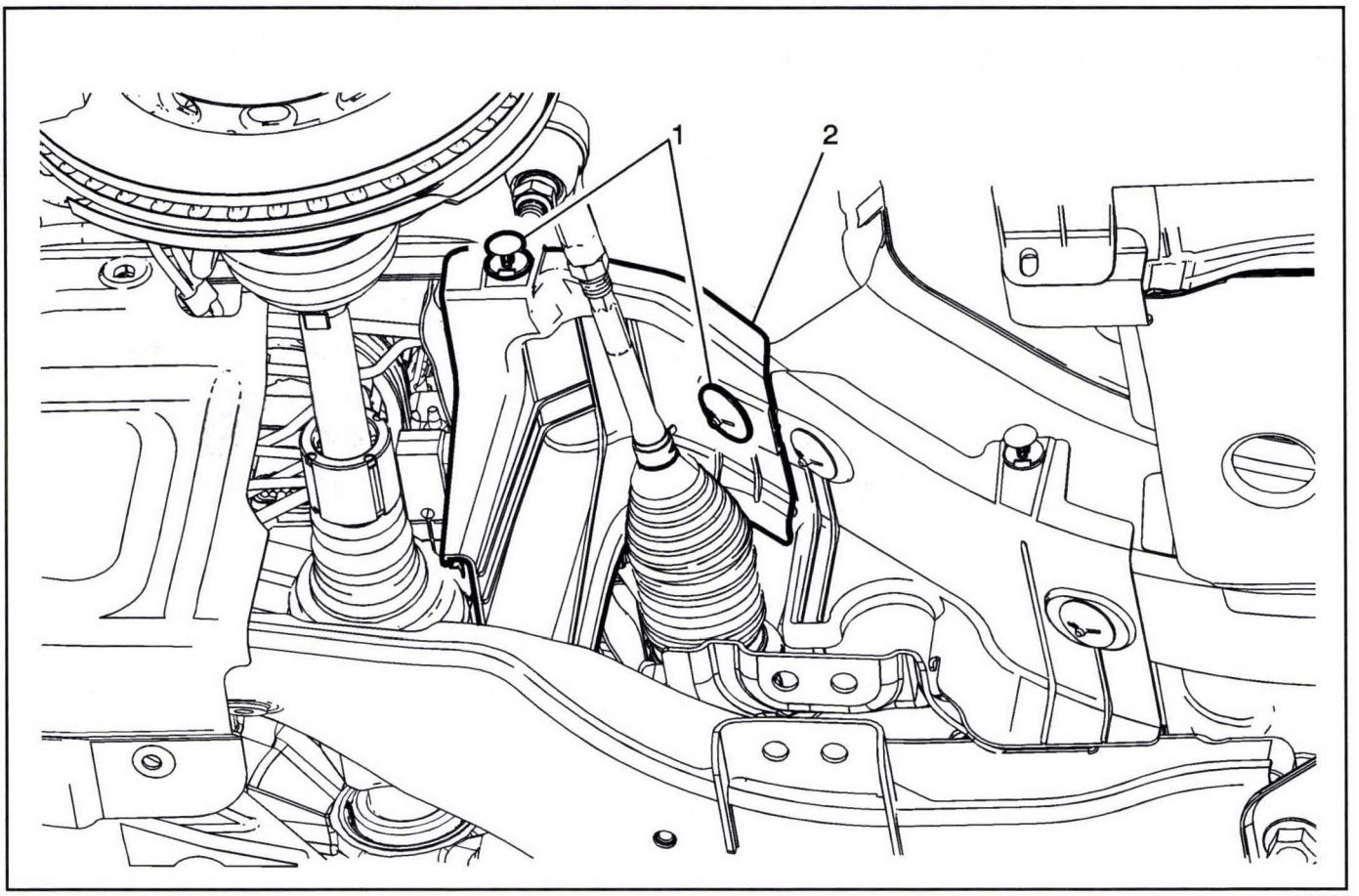


2969467

Front Compartment Splash Shield Replacement (Front)

Callout	Component Name
Preliminary Procedure Remove the front compartment air deflector. Refer to *Front Compartment Air Deflector Replacement on page 3-125*. **Note:** Left side shown, right side similar.	
1	Front Compartment Splash Shield Plastic Retainer (Qty: 2)
2	Front Compartment Splash Shield

Front Compartment Splash Shield Replacement (Middle)

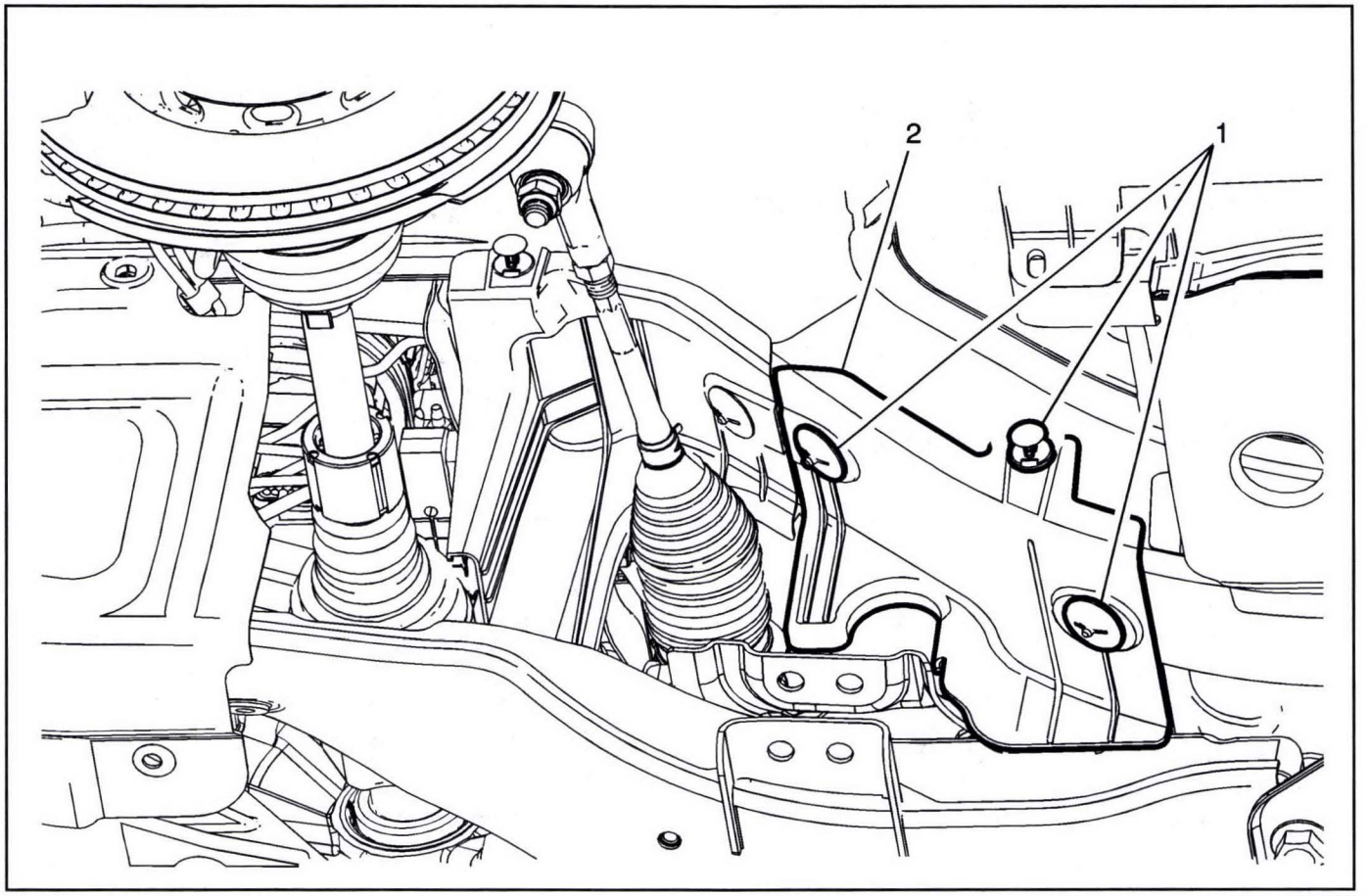


2969470

Front Compartment Splash Shield Replacement (Middle)

Callout	Component Name
Preliminary Procedure Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*. **Note:** Left side shown, right side similar.	
1	Front Compartment Splash Shield Plastic Retainer (Qty: 2)
2	Front Compartment Splash Shield

Front Compartment Splash Shield Replacement (Rear)



2969472

Front Compartment Splash Shield Replacement (Rear)

Callout	Component Name
Preliminary Procedure Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*. **Note:** Left side shown, right side similar.	
1	Front Compartment Splash Shield Plastic Retainer (Qty: 3)
2	Front Compartment Splash Shield

Drivetrain Front and Electronic System Power Supply Module Frame Replacement

Removal Procedure

Danger: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

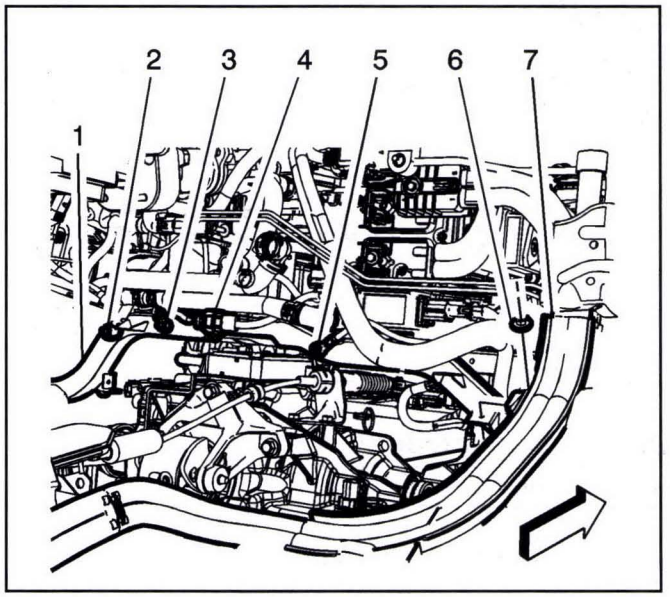
- ***Identify how to disable high voltage.***
- ***Identify how to test for the presence of high voltage.***
- ***Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.***

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- ***Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.***
- ***Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.***
  - ***Visually and functionally inspect the gloves before use.***
  - ***Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.***

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. Refer to *High Voltage Disabling on page 9-363*.
2. Remove the drivetrain and front suspension frame assembly. Refer to *Drivetrain and Front Suspension Frame Replacement on page 3-131*.
3. Remove the drive motor battery coolant flow control valve. Refer to *Drive Motor Battery Coolant Flow Control Valve Replacement on page 9-318*.
4. Remove the heater coolant pump. Refer to *Heater Coolant Pump Replacement on page 10-56*.
5. Remove the accessory DC power control module. Refer to *Accessory DC Power Control Module Replacement on page 9-189*.
6. Remove the drive motor battery charger. Refer to *Drive Motor Battery Charger Replacement on page 9-649*.



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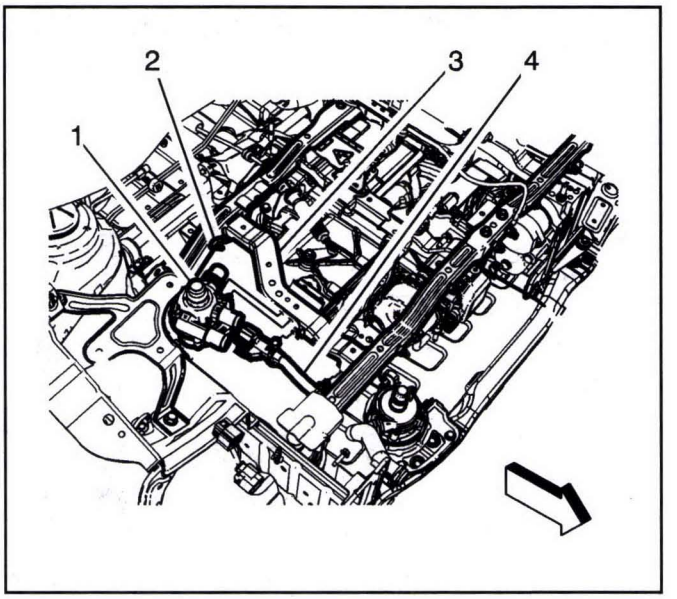
7. Remove the following from the rear of the drivetrain front and electronic system power supply module frame (1) :
   - Battery Positive Cable Ground (2)
   - Engine Wiring Harness Ground (3)
   - Drive Motor Battery Charger Connector (4)
   - Engine Wiring Harness Ground (5)
   - High Voltage Cable Conduit Fastener (6)
   - High Voltage Cable Conduit (7)



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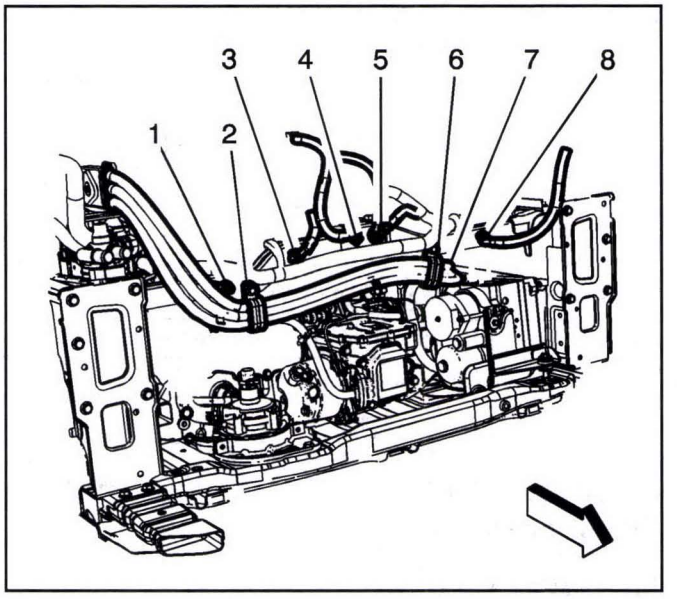
8. Remove the drive motor battery coolant flow control valve (1) from the right side of the drivetrain front and electronic system power supply module frame (3).
9. Remove the auxiliary ground cable (2).
10. Remove the accessory DC power control module connector (4).



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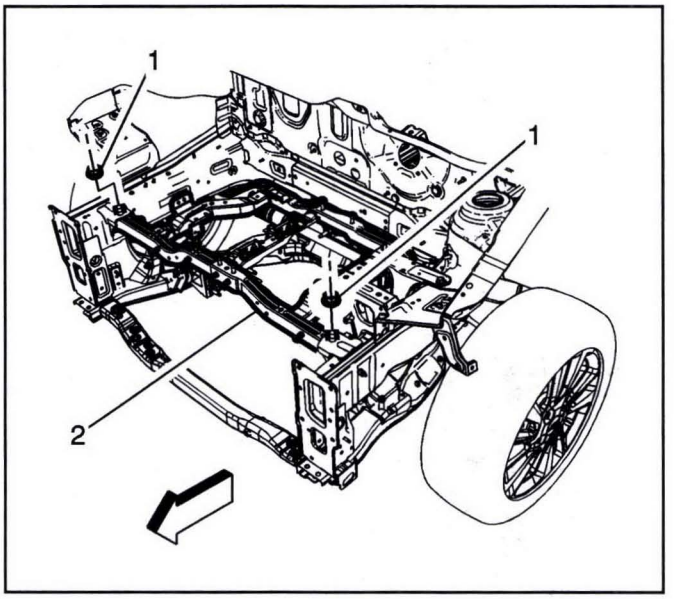
11. Remove the following from the front drive front and electronic system power supply module frame :
    - Engine Wiring Harness Ground (1)
    - Transmission 3 Phase Cable Retainer (2)
    - Accessory DC Power Control Module Cable Ground (3)
    - Auxiliary Battery Negative Cable Ground (4)
    - Engine Wiring Harness Grounds (5)
    - Transmission 3 Phase Cable Retainer (6)

- Transmission 3 Phase Cable (7)
- Battery Negative Cable Ground (8)



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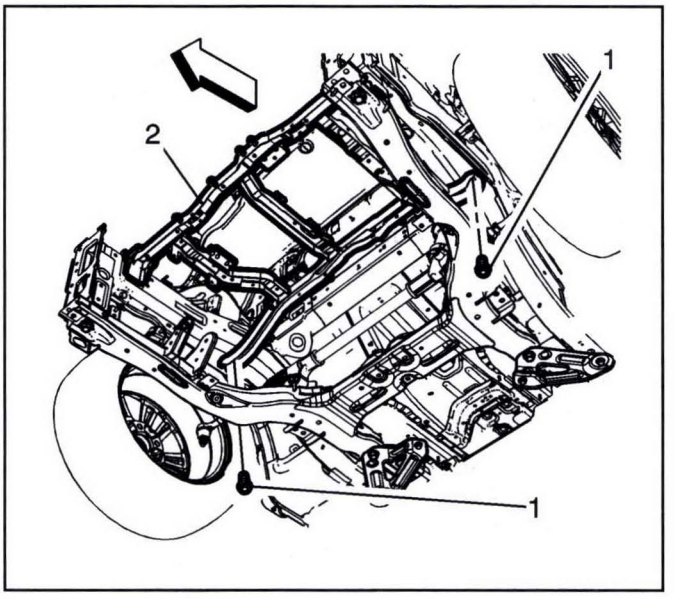
12. Remove the drivetrain front and electronic system power supply module frame mounting nuts (1).



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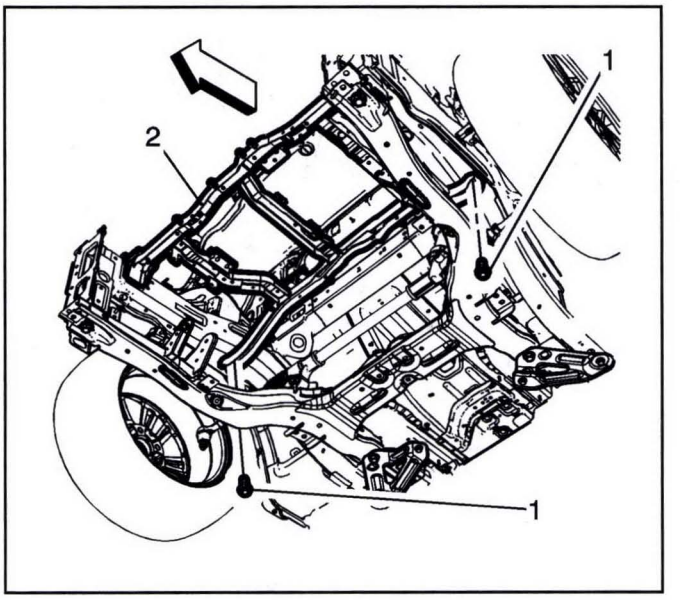
13. Remove the drivetrain front and electronic system power supply module frame mounting bolts (1).
14. With the help of a second technician, remove the frame (2) from the vehicle.

Installation Procedure



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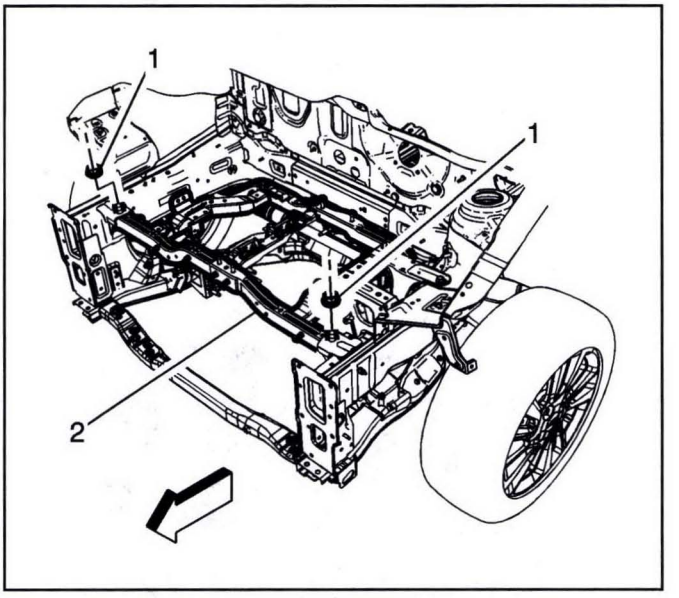
Caution: Refer to *Fastener Caution on page 0-8*.

1. Install the drivetrain front and electronic power supply module frame (2) to the front frame rails and tighten the bolts (1) to **60** N•m **(44 lb ft)**.



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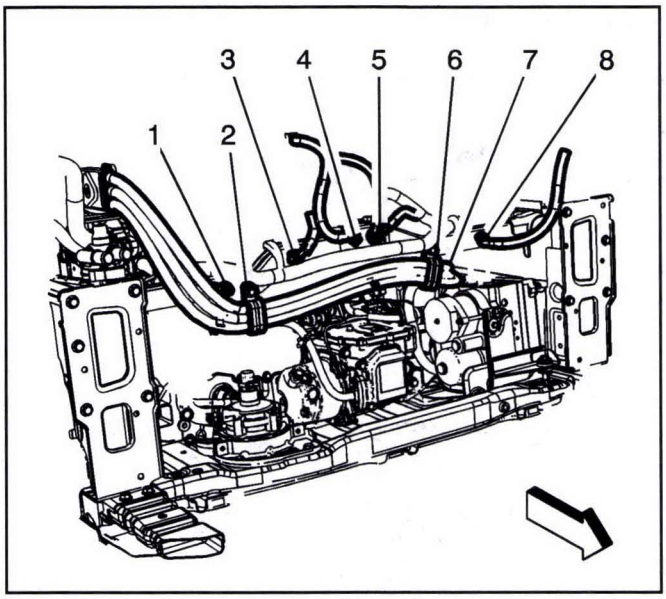
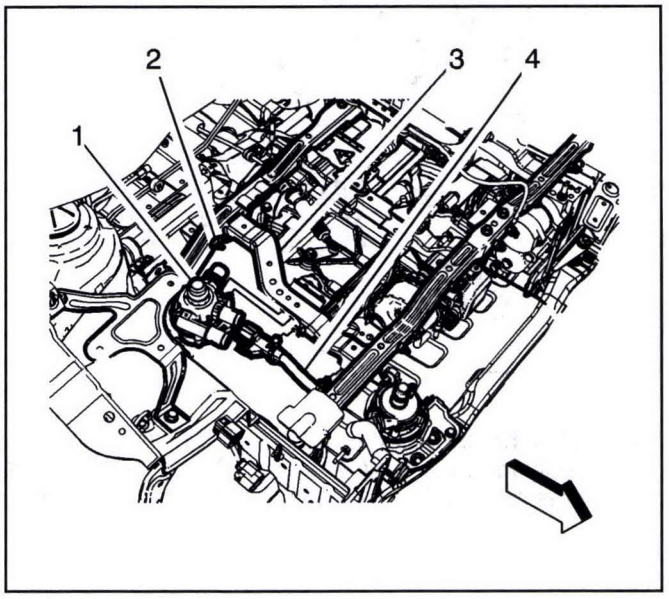
2. Install the drivetrain front and electronic power supply module frame mounting nuts (1) to the front frame rail brackets and tighten to **80** N•m **(59 lb ft)**.



3282802

3. Install the following to the front of the drivetrain front and electronic system power supply module frame :
   - Engine Wiring Harness Ground (1)
   - Transmission 3 Phase Cable Retainer (2)
   - Accessory DC Power Control Module Cable Ground (3)
   - Auxiliary Battery Negative Cable Ground (4)
   - Engine Wiring Harness Grounds (5)
   - Transmission 3 Phase Cable Retainer (6)
   - Transmission 3 Phase Cable (7)
   - Battery Negative Cable Ground (8)



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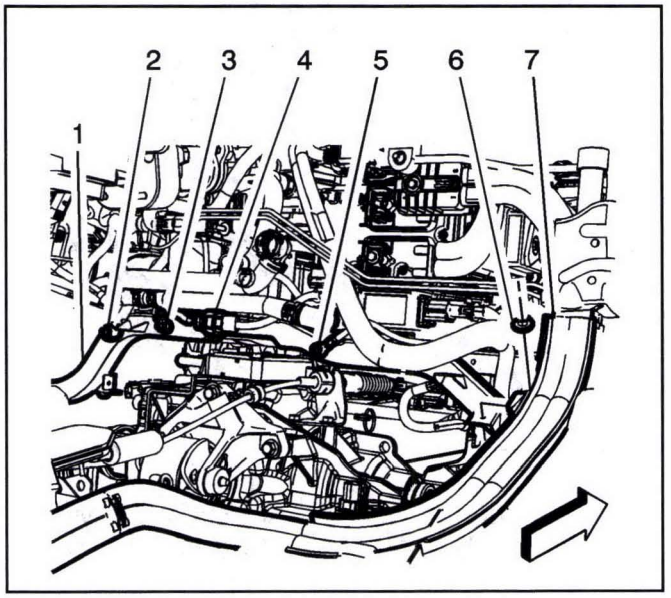
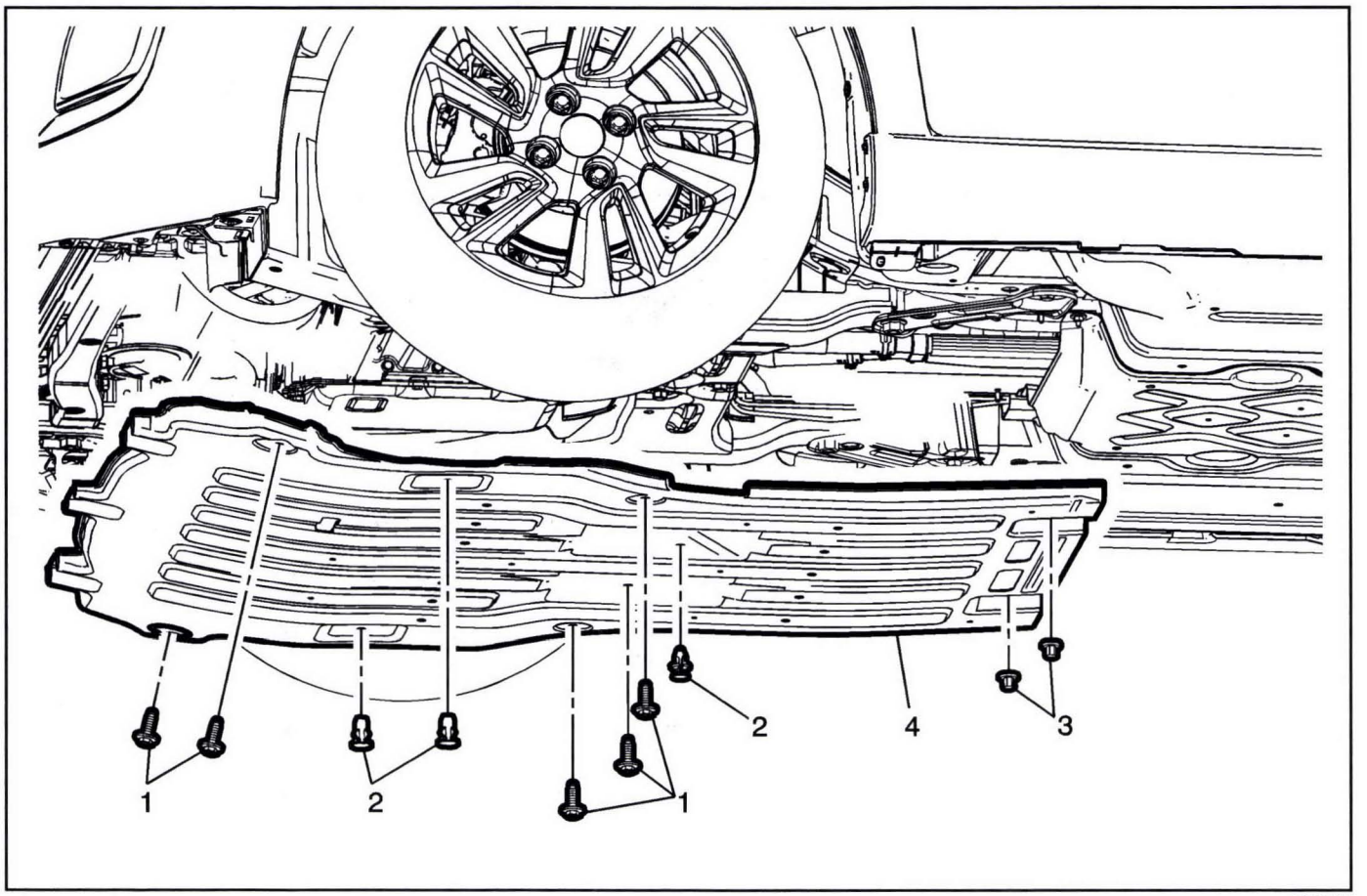
4. Install the drivetrain motor battery coolant flow control valve (1) to the right side of the drivetrain front and electronic system power supply module frame (3).
5. Install the auxiliary ground cable (2).
6. Install the accessory DC power control module connector (4).
7. Install the heater coolant pump. Refer to *Heater Coolant Pump Replacement on page 10-56*.
8. Install the drive motor battery coolant flow control valve. Refer to *Drive Motor Battery Coolant Flow Control Valve Replacement on page 9-318*.



3282803

9. Install the following to the rear of the drivetrain front and electronic system power supply module frame (1) :
   - Battery Positive Cable Ground (2)
   - Engine Wiring Harness Ground (3)
   - Drive Motor Battery Charger Connector (4)
   - Engine Wiring Harness Ground (5)
   - High Voltage Cable Conduit Fastener (6)
   - High Voltage Cable Conduit (7)
10. Install the drive motor battery charger. Refer to *Drive Motor Battery Charger Replacement on page 9-649*.
11. Install the accessory DC power control module. Refer to *Accessory DC Power Control Module Replacement on page 9-189*.
12. Install the drivetrain and front suspension frame assembly. Refer to *Drivetrain and Front Suspension Frame Replacement on page 3-131*.
13. Enable the high voltage system. Refer to *High Voltage Enabling on page 9-367*.

Front Compartment Air Deflector Replacement



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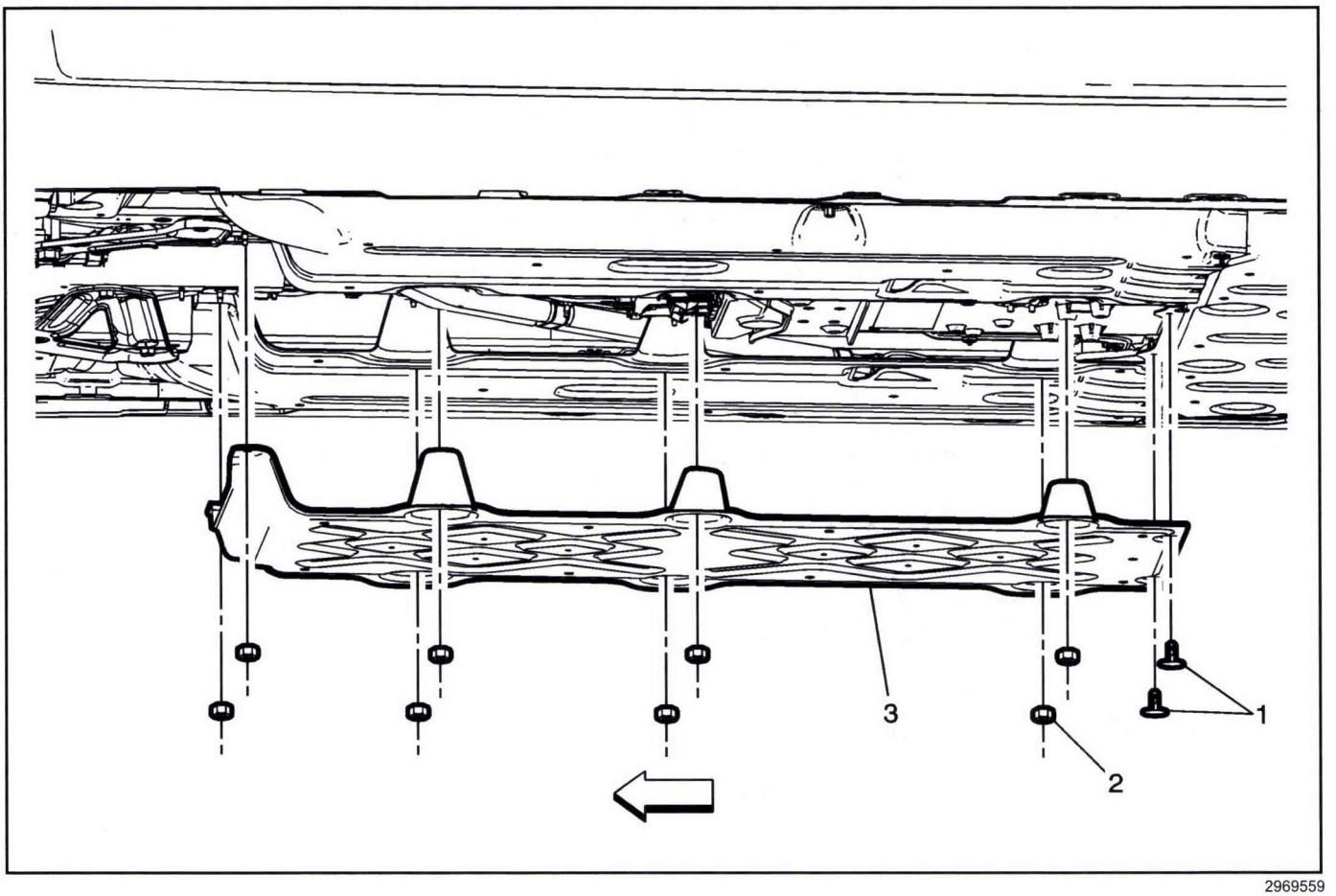
Front Compartment Air Deflector Replacement

Callout	Component Name
Preliminary Procedure Remove the rear center 3 screws from the Front Bumper Fascia Opening Lower Cover. Refer to *Front Bumper Fascia Air Deflector Replacement on page 3-62*.	
1	Front Compartment Air Deflector Bolts (Qty: 5) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 22 N•m (16 lb ft)
2	Front Compartment Air Deflector Plastic Retainers (Qty: 3)
3	Front Compartment Air Deflector Nuts (Qty: 2) **Tighten** 4 N•m (35 lb in)
4	Front Compartment Air Deflector

Underbody Front Air Deflector Replacement (Center)



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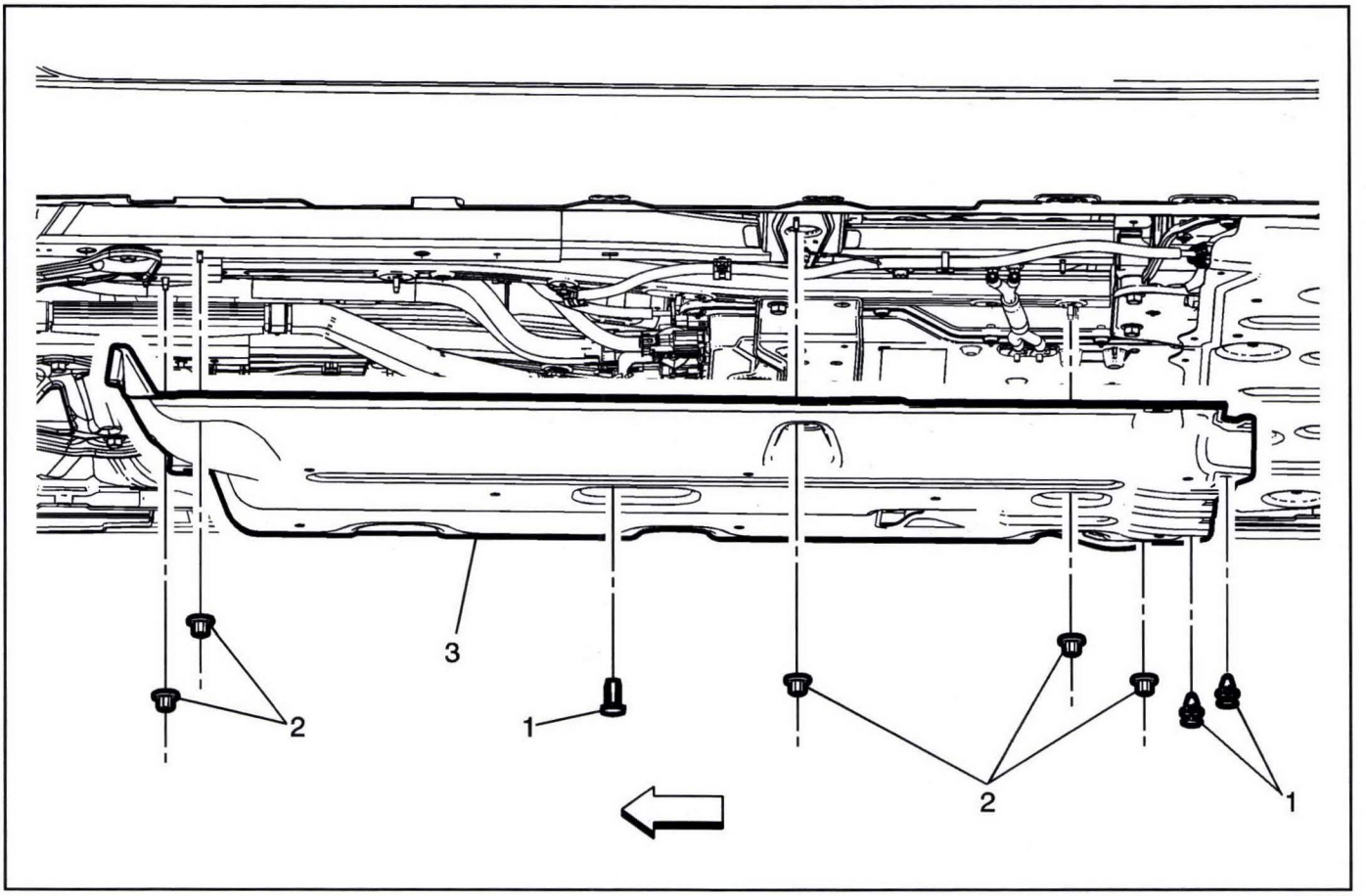
Underbody Front Air Deflector Replacement (Center)

Callout	Component Name
Preliminary Procedure *Front Compartment Air Deflector Replacement on page 3-125.*	
1	Underbody Front Air Deflector Plastic Retainers (Qty: 8)
2	Underbody Front Air Deflector (Qty: 8) **Caution:** Refer to *Fastener Caution on page 0-8.* **Tighten** 1.5 N•m (13 lb in)
3	Underbody Front Air Deflector

Underbody Front Air Deflector Replacement - Left Side



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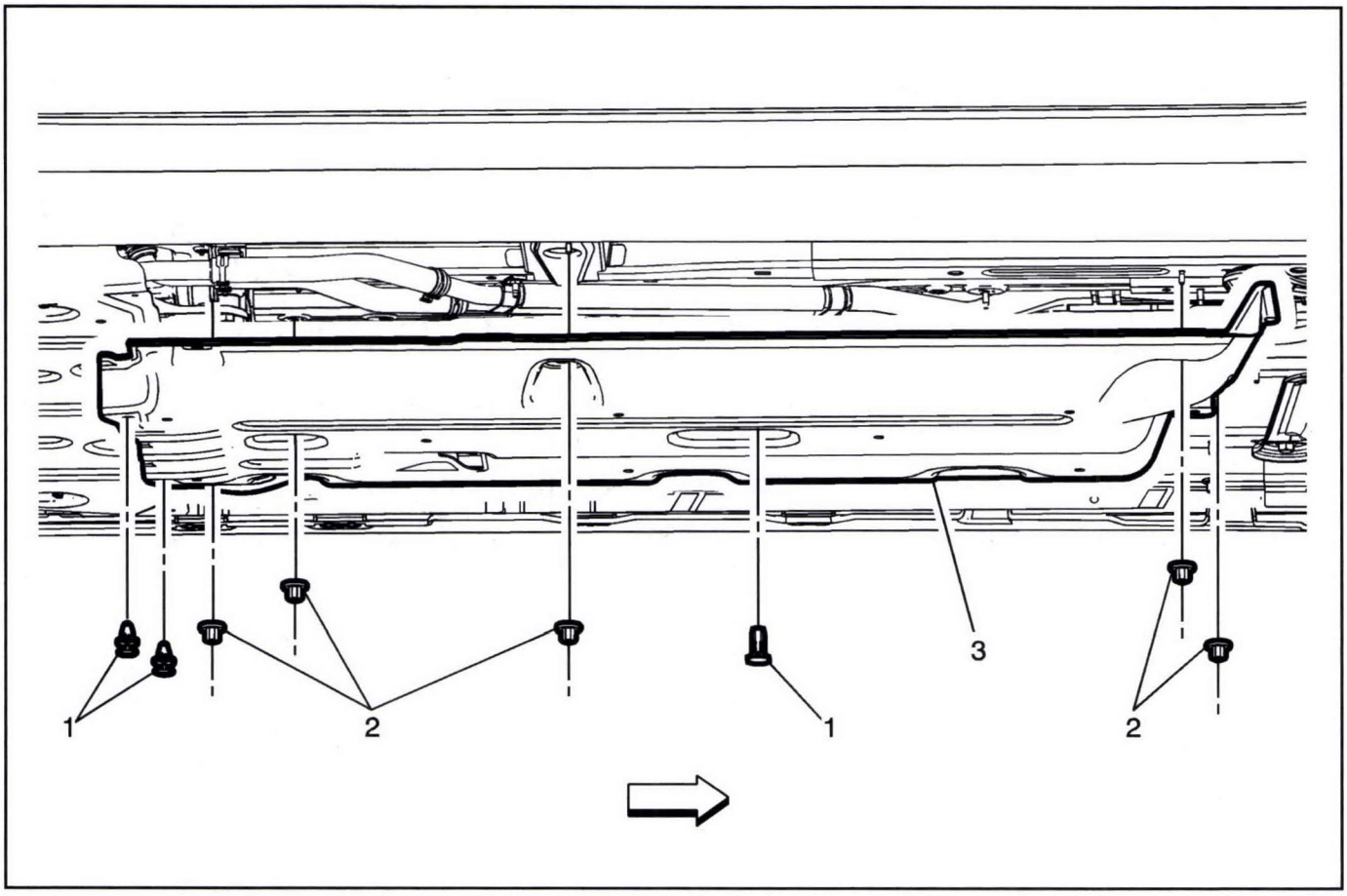
Underbody Front Air Deflector Replacement - Left Side

Callout	Component Name
Preliminary Procedure Remove the Center Underbody Front Air Deflector. Refer to *Underbody Front Air Deflector Replacement (Center) on page 3-126*.	
1	Left Underbody Front Air Deflector Plastic Retainers (Qty: 3)
2	Left Underbody Front Air Deflector (Qty: 5) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 1.5 N•m (13 lb in)
3	Left Underbody Front Air Deflector

Underbody Front Air Deflector Replacement - Right Side

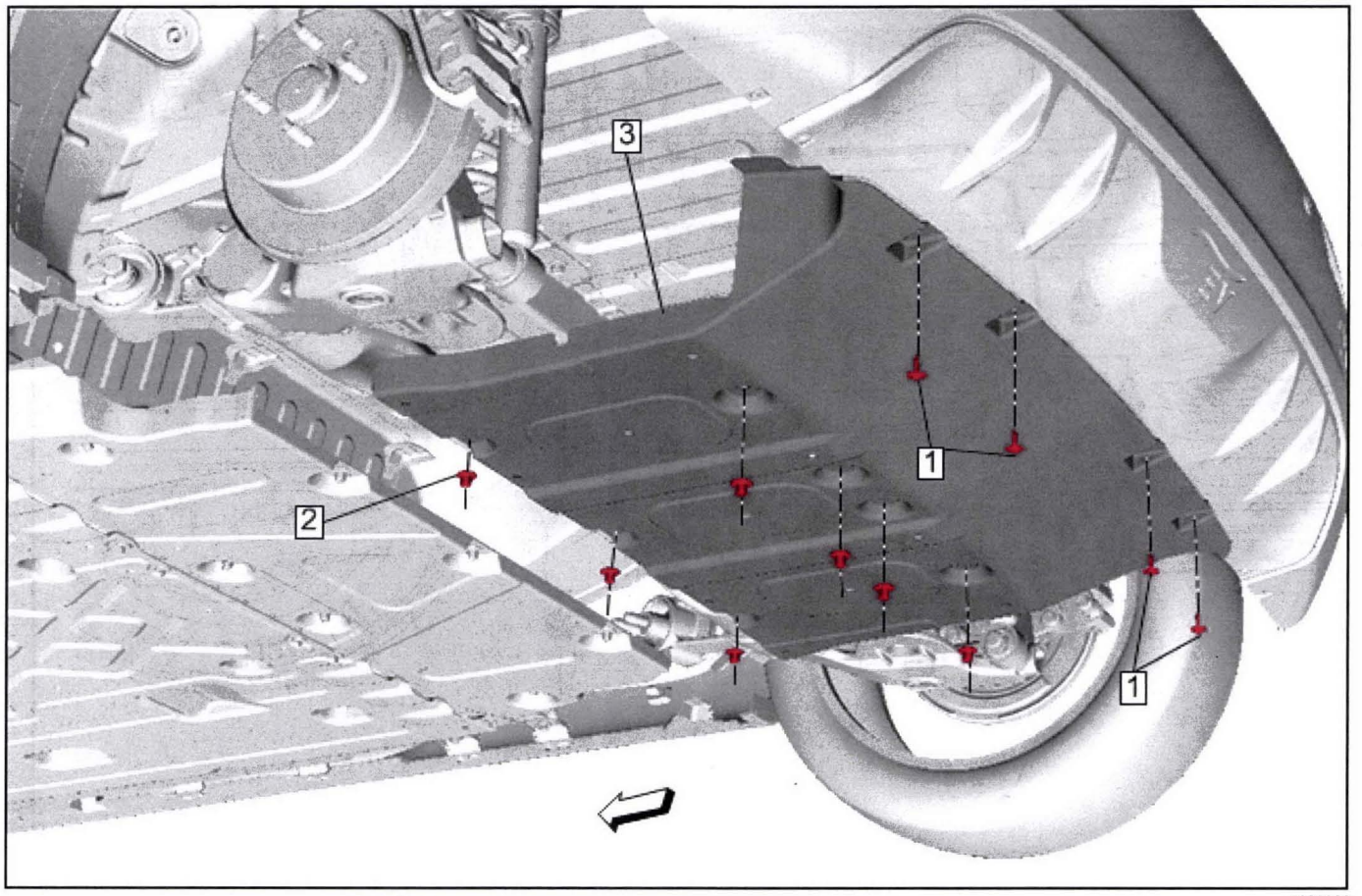


2969564

Underbody Front Air Deflector Replacement - Right Side

Callout	Component Name
Preliminary Procedure Remove the Center Underbody Front Air Deflector. Refer to *Underbody Front Air Deflector Replacement (Center) on page 3-126*.	
1	Right Underbody Front Air Deflector Plastic Retainers (Qty: 3)
2	Right Underbody Front Air Deflector (Qty: 5) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 1.5 N•m (13 lb in)
3	Right Underbody Front Air Deflector

Underbody Rear Air Rear Deflector Replacement (Rear)



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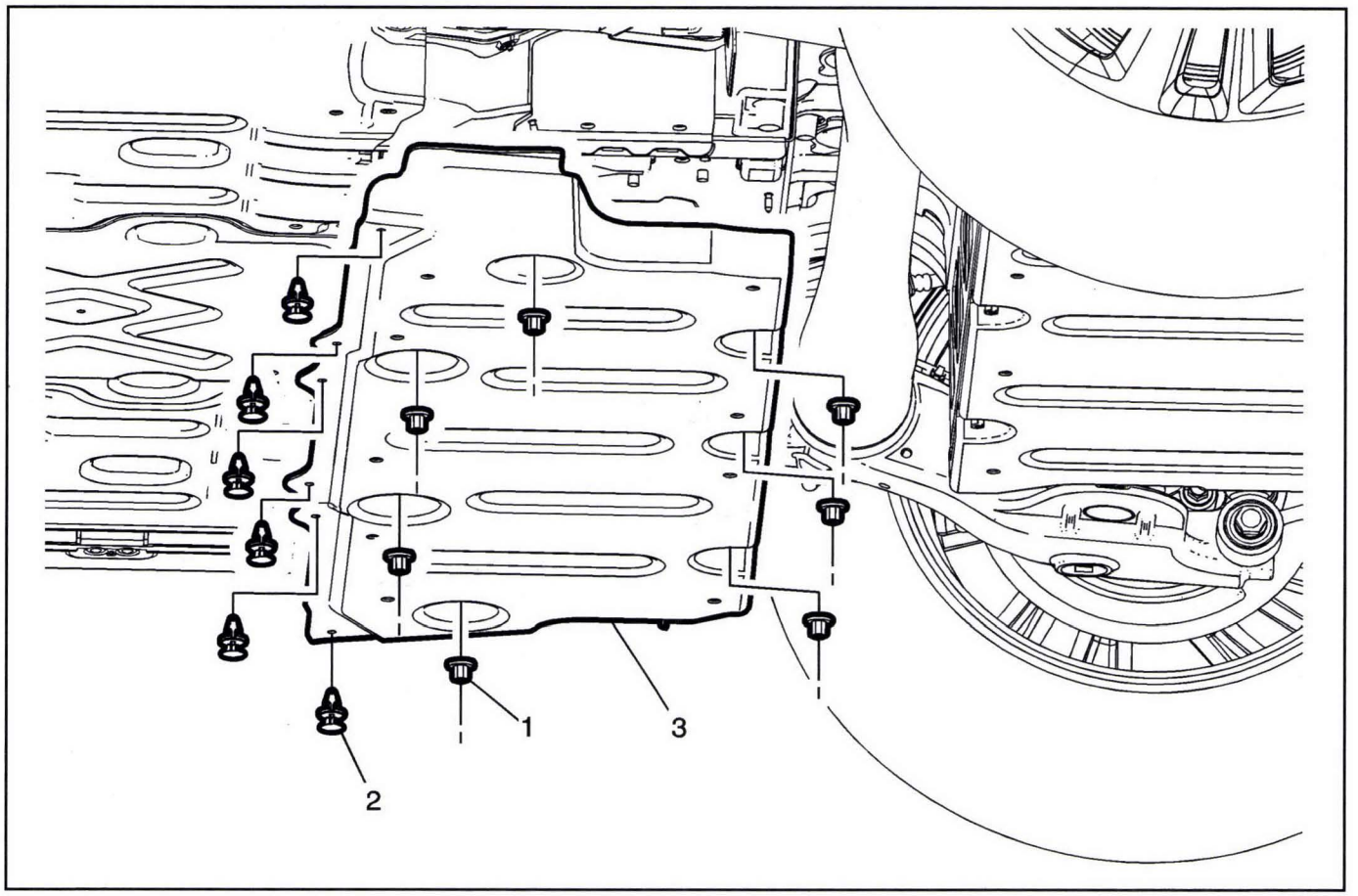
Underbody Rear Air Rear Deflector Replacement (Rear)

Callout	Component Name
Preliminary Procedure *Lifting and Jacking the Vehicle on page 1-27.*	
1	Underbody Rear Air Deflector Screw [4X] **Caution:** Refer to *Fastener Caution on page 0-8.* **Tighten** 1.5 N•m (13 lb in)
2	Underbody Rear Air Deflector Nut [7X] **Tighten** 2.5 N•m (22 lb in)
3	Underbody Rear Air Deflector

Underbody Rear Air Rear Deflector Replacement (Front)

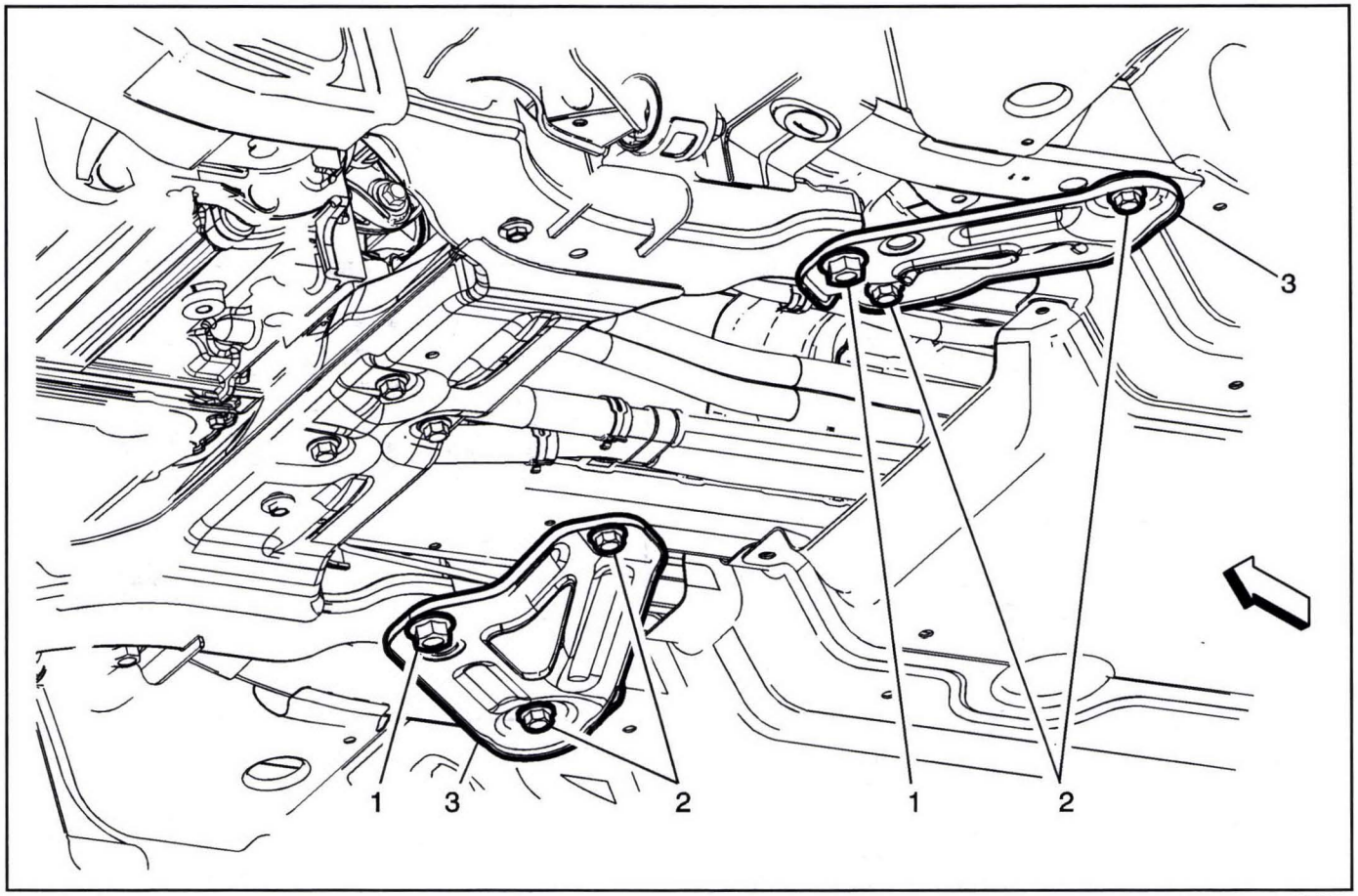


3016326

Underbody Rear Air Rear Deflector Replacement (Front)

Callout	Component Name
Preliminary Procedure Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.	
1	Underbody Rear Air Front Deflector Nuts (Qty: 7) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 1.5 N•m (13 lb in)
2	Underbody Rear Air Front Deflector Plastic Retainers (Qty: 6)
3	Underbody Rear Air Front Deflector

Drivetrain and Front Suspension Frame Stabilizer Bracket Replacement



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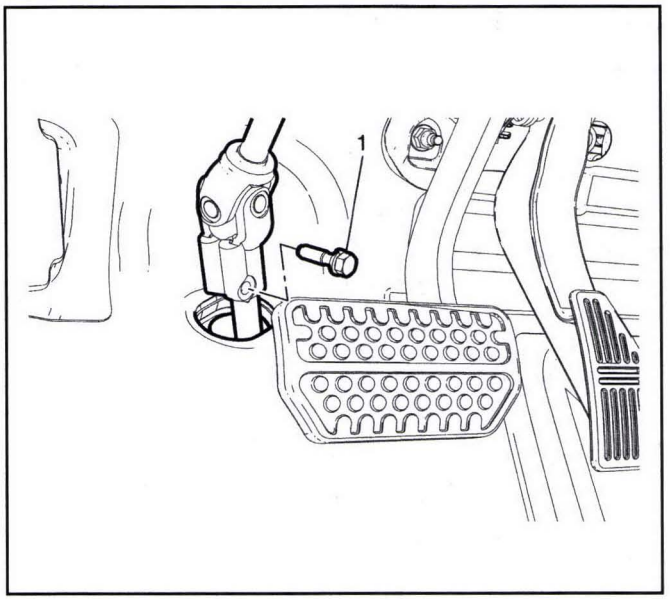
Drivetrain and Front Suspension Frame Stabilizer Bracket Replacement

Callout	Component Name
Preliminary Procedure Remove the Front Compartment Air Deflector. Refer to *Front Compartment Air Deflector Replacement on page 3-125*.	
1	Rear Drivetrain and Front Suspension Frame Bolts (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 135 N•m (100 lb ft)
2	Drivetrain and Front Suspension Frame Stabilizer Bracket Bolts (Qty: 4) **Tighten** 60 N•m (44 lb ft)
3	Drivetrain and Front Suspension Frame Stabilizer Bracket

Drivetrain and Front Suspension Frame Replacement

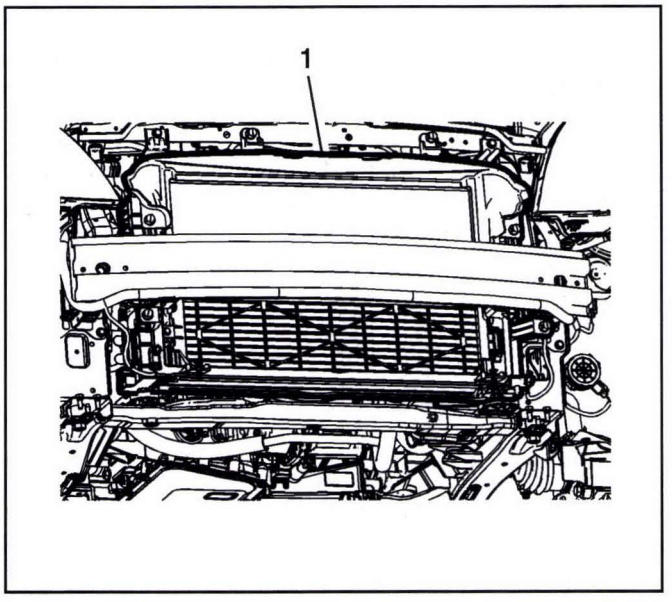
Removal Procedure

1. Before performing this procedure, review the high voltage safety information. Refer to *High Voltage Safety on page 9-362*.
2. Disable the high voltage systems. Refer to *High Voltage Disabling on page 9-363*.
3. With the steering wheel in the straight ahead position, LOCK the steering column.



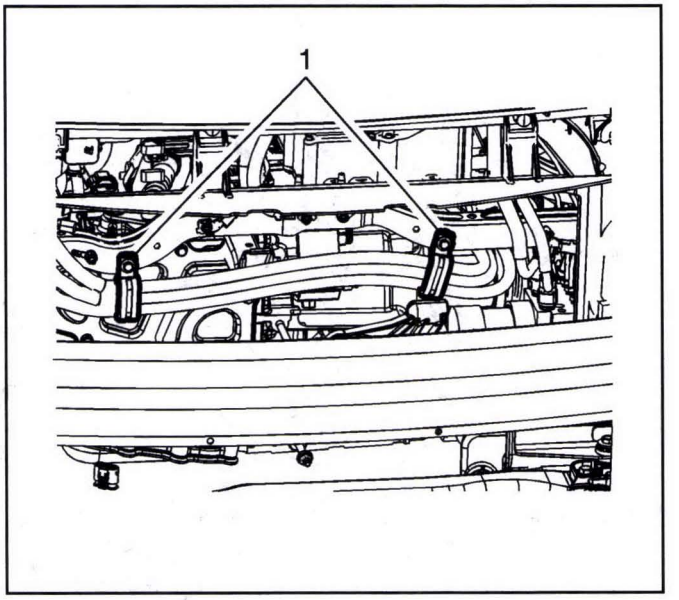
2308813

4. Disconnect the steering intermediate shaft from the steering gear assembly. Refer to *Intermediate Steering Shaft Replacement on page 14-28*.
5. Remove the intermediate steering shaft inner boot. Refer to *Intermediate Steering Shaft Inner Boot Replacement on page 14-27*.
6. Remove the front compartment air deflector. Refer to *Front Compartment Air Deflector Replacement on page 3-125*.
7. Remove the front, middle and rear portion of the front compartment splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.
8. Remove the front bumper lower impact bar. Refer to *Front Bumper Lower Impact Bar Replacement on page 3-56*.



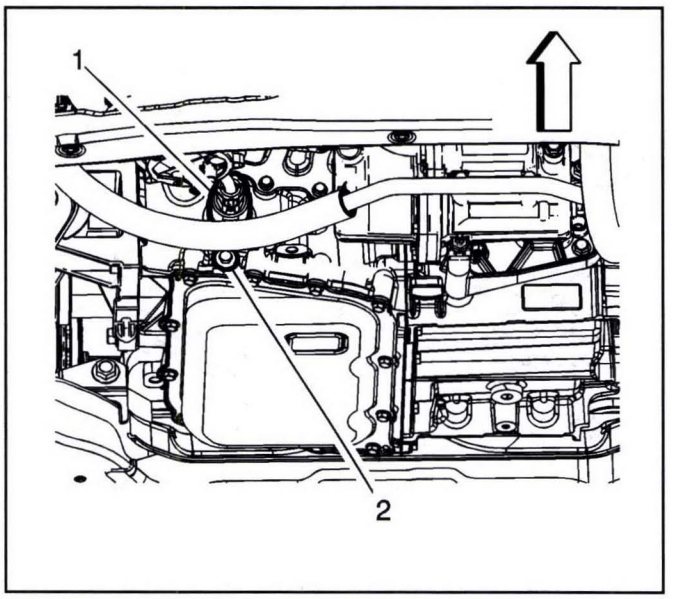
3106897

9. Secure the radiator cooling module (1) to the left and right of the upper body structure with mechanics wire.
10. Disconnect the range selector lever cable from transmission. Refer to *Range Selector Lever Cable Replacement on page 16-36*.



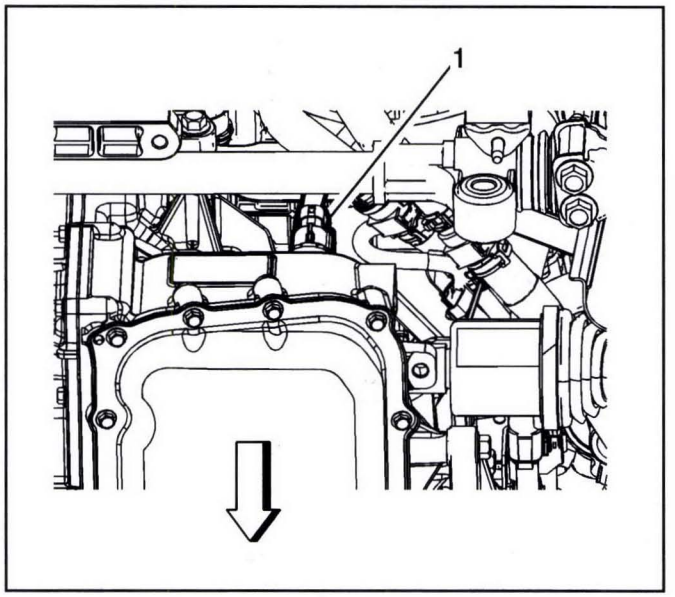
3121919

11. Remove the high voltage cable retainer bolts (1), then disconnect the cables on the drive motor generator power inverter module assembly. Refer to *Drive Motor Generator Power Inverter Module Replacement on page 9-184*.
12. Disconnect the left and right stabilizer shaft links from the left and right shock absorber struts. Refer to *Stabilizer Shaft Link Replacement on page 15-5*.
13. Disconnect the left and right steering linkage outer tie rod ends from the steering knuckle. Refer to *Steering Linkage Outer Tie Rod Replacement on page 14-14*.
14. Disconnect the left and right control arm ball joints from the steering knuckle. Refer to *Lower Control Arm Replacement on page 15-9*.
15. Remove the left front wheel drive shaft. Refer to *Front Wheel Drive Shaft Replacement - Left Side on page 7-4*.
16. Remove the right front wheel drive shaft. Refer to *Front Wheel Drive Shaft Replacement - Right Side on page 7-7*.
17. Remove air conditioning compressor from the drive unit. Refer to *Air Conditioning Compressor Replacement on page 10-26*.



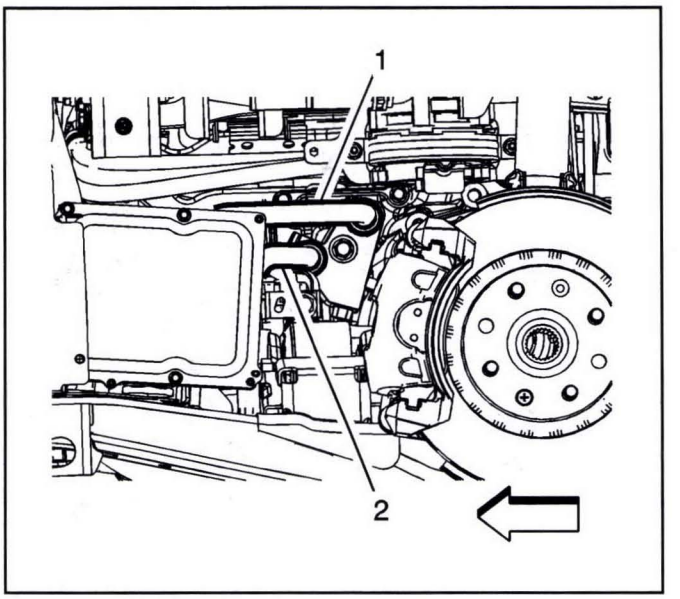
3102960

18. Disconnect the automatic transmission control connector (1) from the front of the transmission.



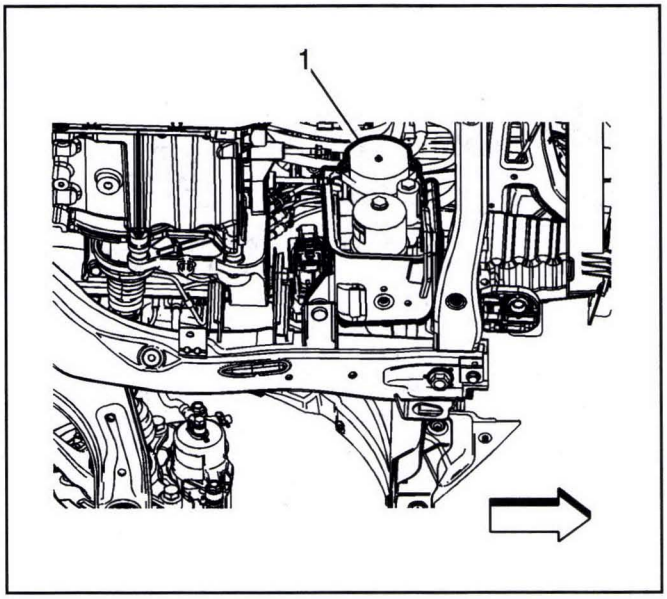
3104065

19. Disconnect the transmission fluid pump connector (1) from the rear of the transmission.



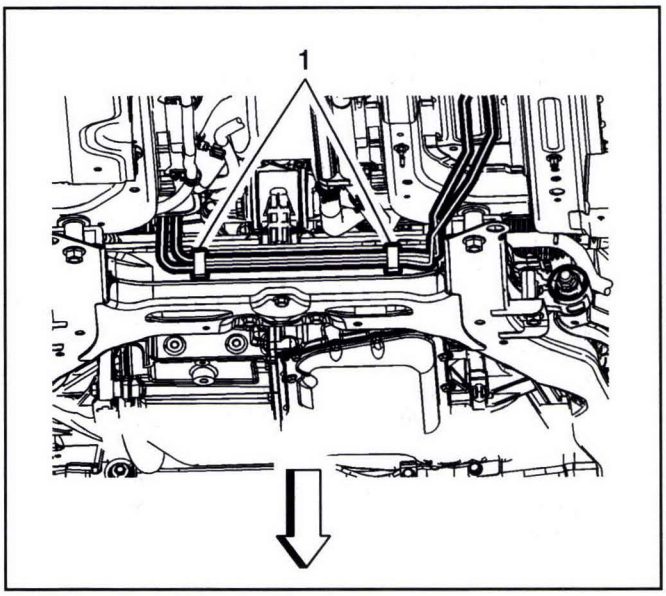
3124101

20. Disconnect the transmission fluid cooler outlet pipe (2) from the transmission drive unit. Refer to *Transmission Fluid Cooler Outlet Pipe Replacement on page 16-120*.
21. Disconnect the transmission fluid cooler inlet pipe (1) from the transmission drive unit. Refer to *Transmission Fluid Cooler Inlet Pipe Replacement on page 16-119*.
22. Support the drive unit and transmission using a hydraulic jack and a suitable supporter.
23. Remove the left side transmission mount. Refer to *Transmission Mount Replacement - Left Side on page 16-52*.
24. Remove the right side transmission mount. Refer to *Transmission Mount Replacement - Right Side on page 16-53*.
25. Remove the rear transmission mount bracket. Refer to *Transmission Rear Mount Bracket Replacement on page 16-50*.
26. Lower the hydraulic jack and remove the transmission and drive unit assembly from the vehicle.



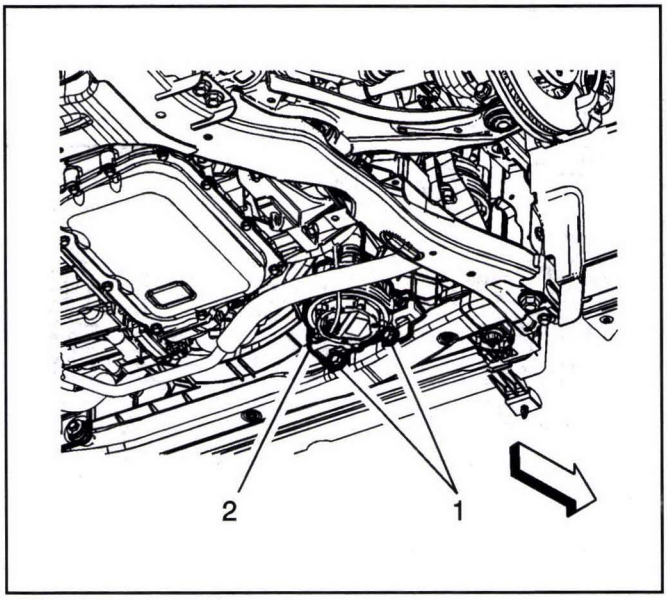
3117670

27. Remove the electro hydraulic control module assembly (1) fasteners, then using mechanics wire support the assembly.



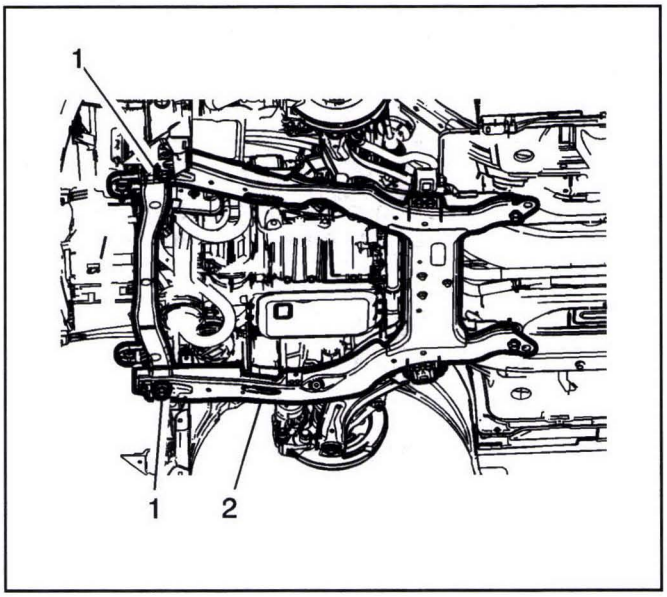
3108997

28. Disconnect the brake line clips (1) from the drivetrain and front suspension frame.



3107637

29. Remove the drive motor generator control module coolant pump retaining nuts (1), then position the pump (2) out of the way. Refer to *Drive Motor Generator Control Module Coolant Pump Replacement on page 9-291*.
30. Remove the drive motor battery coolant pump retaining nuts, then position the pump out of the way. Refer to *Drive Motor Battery Coolant Pump Replacement on page 9-315*.
31. Support the frame using a hydraulic jack and suitable supporter.
32. Remove the two drivetrain and front suspension frame stabilizer brackets. Refer to *Drivetrain and Front Suspension Frame Stabilizer Bracket Replacement on page 3-131*.
33. Mark the frame to body positions with a paint pen or permanent marker.



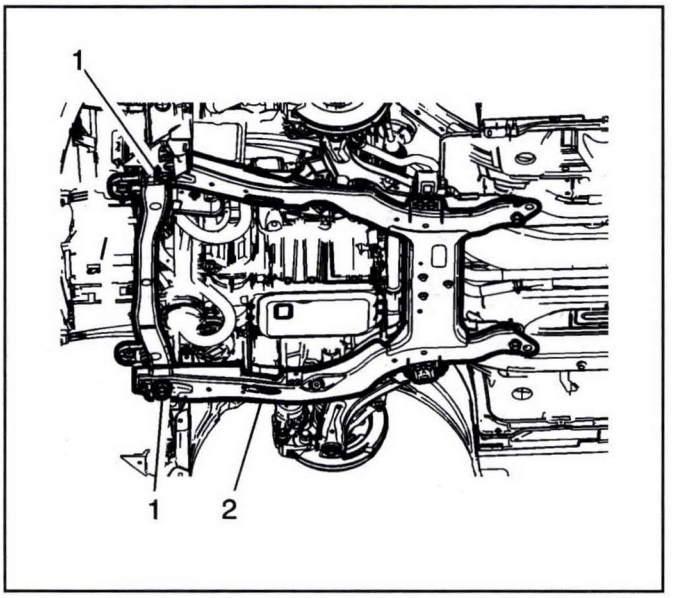
3346973

34. Remove the front drivetrain and front suspension frame bolts (1).

35. Disconnect the upper conduit retainer bracket from the drivetrain front and electronic system power supply module frame and disconnect the lower conduit retainer bracket from the drivetrain and front suspension frame. Refer to *300-Volt Battery Positive and Negative Cable Replacement (Drive Motor Generator Power Inverter Module to Drive Motor Battery) on page 9-454* or *300-Volt Battery Positive and Negative Cable Replacement (Drive Motor Generator Power Inverter Module to High Voltage Battery Disconnect Module) on page 9-457*.
36. Lower the hydraulic jack and remove the frame assembly (2) from the vehicle.
37. If replacing the frame, transfer components as necessary.

Installation Procedure

1. Raise the hydraulic jack and install the frame assembly to the vehicle.
2. Connect the upper conduit retainer bracket from the drivetrain front and electronic system power supply module frame and disconnect the lower conduit retainer bracket from the drivetrain and front suspension frame. Refer to *300-Volt Battery Positive and Negative Cable Replacement (Drive Motor Generator Power Inverter Module to Drive Motor Battery) on page 9-454* or *300-Volt Battery Positive and Negative Cable Replacement (Drive Motor Generator Power Inverter Module to High Voltage Battery Disconnect Module) on page 9-457*.

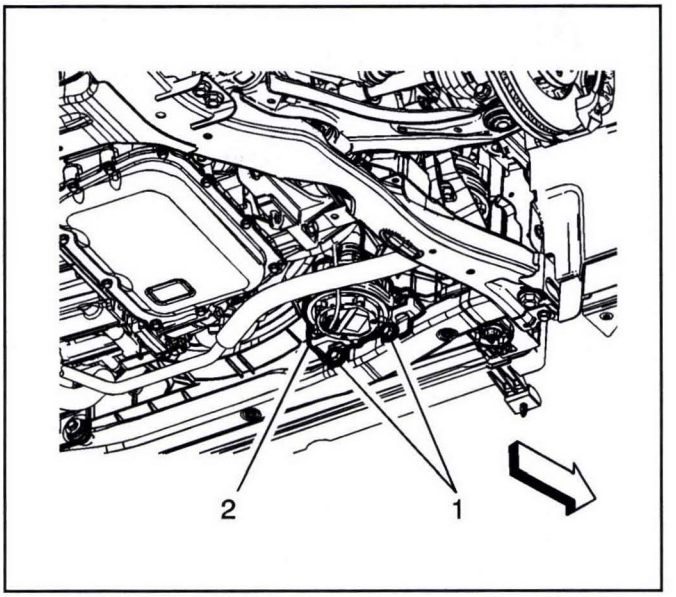


3346973

3. Hand start the front frame to body retaining bolts (1) while aligning the frame (2) to the paint marks.

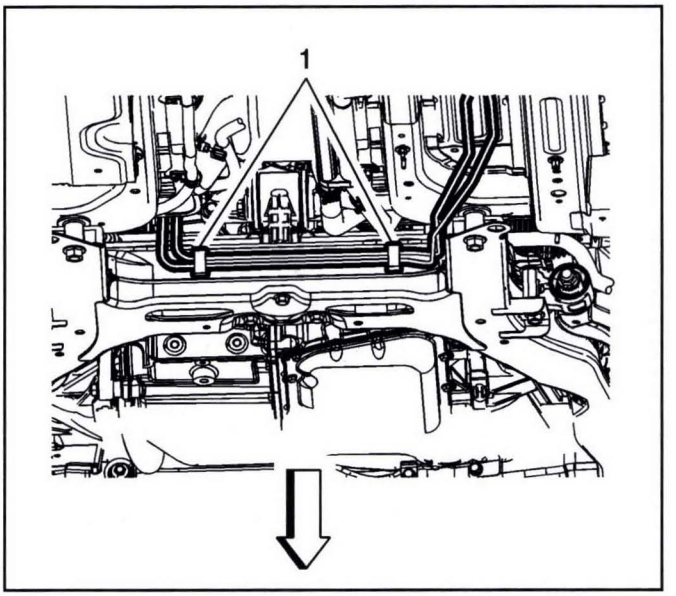
Caution: Refer to *Fastener Caution on page 0-8*.

4. Tighten the front frame to body retaining bolts (1) to **135** N•m **(100 lb ft)**.
5. Install the two drivetrain and front suspension frame stabilizer brackets. Refer to *Drivetrain and Front Suspension Frame Stabilizer Bracket Replacement on page 3-131*.
6. Install the drive motor battery coolant pump and the retaining nuts. Refer to *Drive Motor Battery Coolant Pump Replacement on page 9-315*.



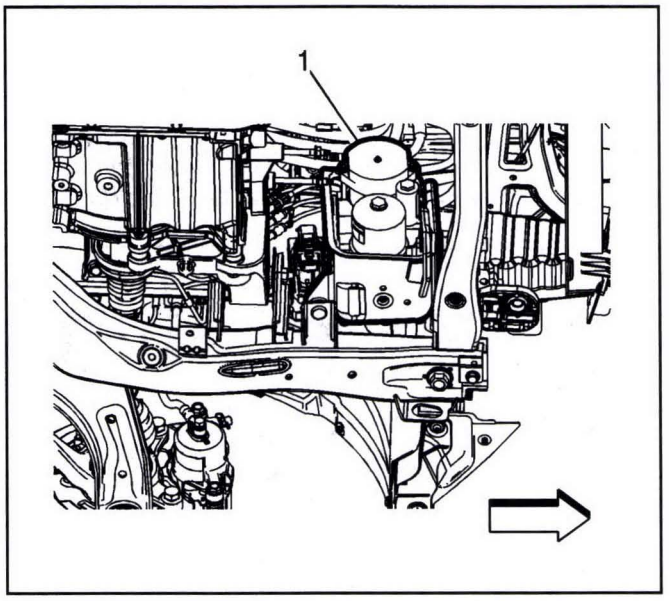
3107637

7. Install the drive motor generator control module coolant pump (2) and the retaining nuts (1). Refer to *Drive Motor Generator Control Module Coolant Pump Replacement on page 9-291*.



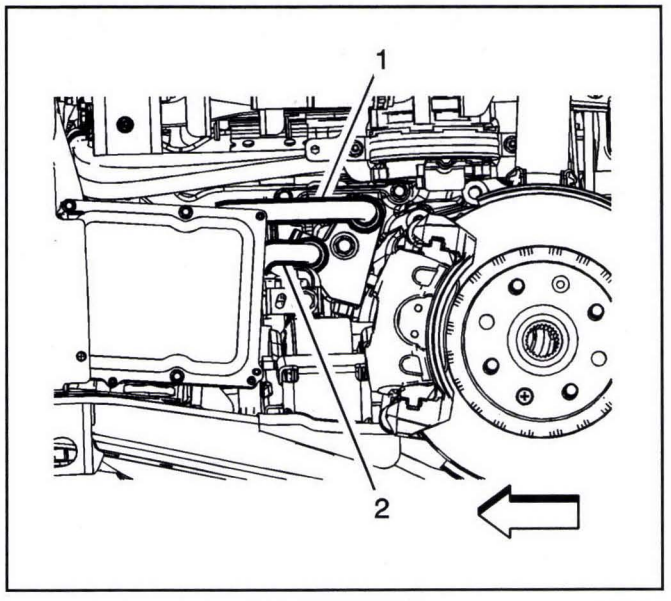
3108997

8. Connect the brake line clips (1) to the drivetrain and front suspension frame.



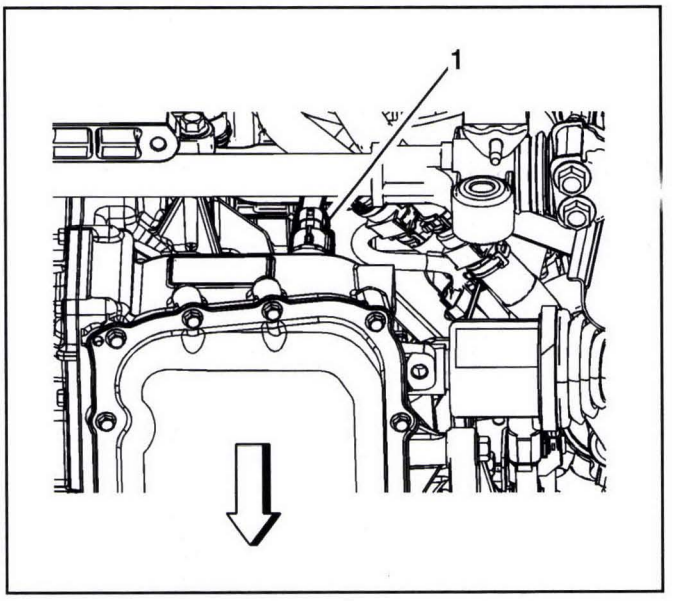
3117670

9. Install the electro hydraulic control module assembly (1) to the frame and remove the mechanics wire. Refer to *Brake Pressure Modulator Valve Replacement on page 5-76*.
10. Raise the hydraulic jack and install the transmission and drive unit assembly to the vehicle.
11. Install the rear transmission mount bracket. Refer to *Transmission Rear Mount Bracket Replacement on page 16-50*.
12. Install the right side transmission mount. Refer to *Transmission Mount Replacement - Right Side on page 16-53*.
13. Install the left side transmission mount. Refer to *Transmission Mount Replacement - Left Side on page 16-52*.



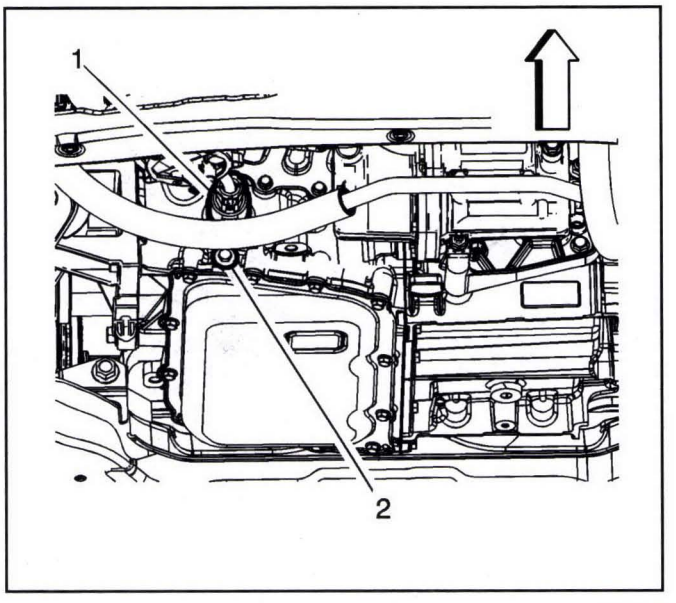
3124101

14. Connect the transmission fluid cooler inlet pipe (1) to the transmission drive unit. Refer to *Transmission Fluid Cooler Inlet Pipe Replacement on page 16-119*.
15. Connect the transmission fluid cooler outlet pipe (2) to the transmission drive unit. Refer to *Transmission Fluid Cooler Outlet Pipe Replacement on page 16-120*.



3104065

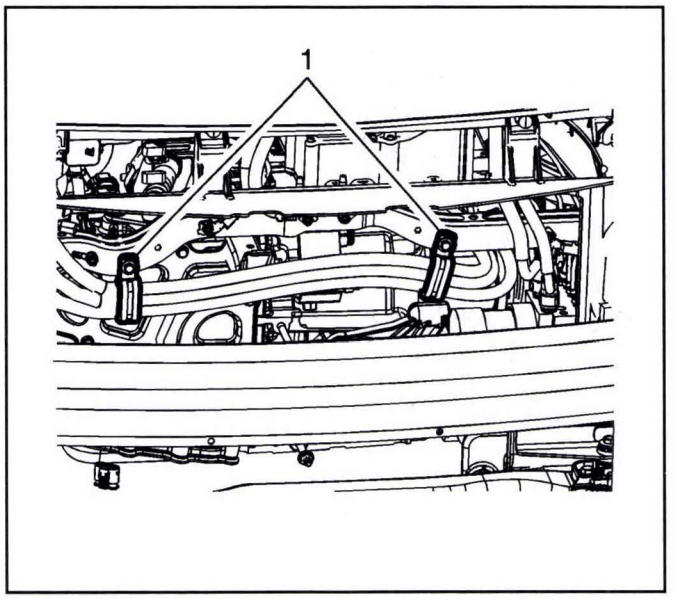
16. Connect the transmission fluid pump connector (1) to the rear of the transmission.



3102960

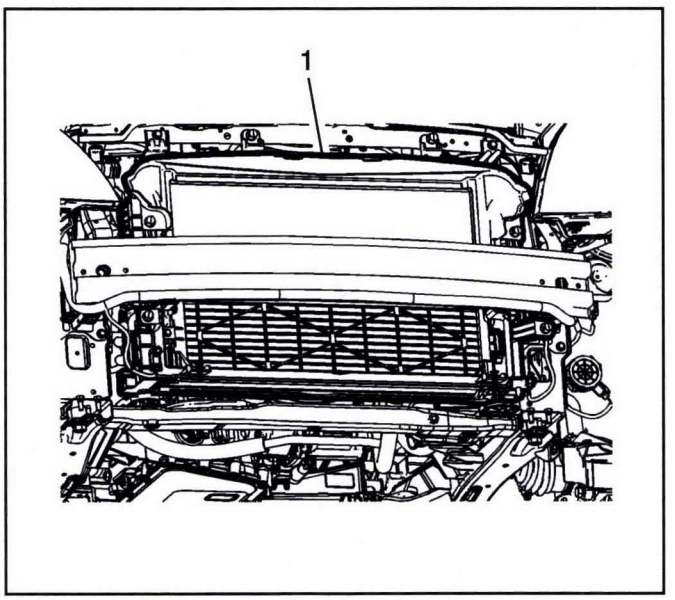
17. Connect the automatic transmission control connector (1) to the front of the transmission.
18. Install air conditioning compressor to the drive unit. Refer to *Air Conditioning Compressor Replacement on page 10-26*.
19. Install the right front wheel drive shaft. Refer to *Front Wheel Drive Shaft Replacement - Right Side on page 7-7*.

20. Install the left front wheel drive shaft. Refer to *Front Wheel Drive Shaft Replacement - Left Side on page 7-4*.
21. Connect the left and right control arm ball joints to the steering knuckle. Refer to *Lower Control Arm Replacement on page 15-9*.
22. Connect the left and right steering linkage outer tie rod ends to the steering knuckle.
23. Connect the left and right stabilizer shaft links to the left and right shock absorber struts. Refer to *Stabilizer Shaft Link Replacement on page 15-5*.



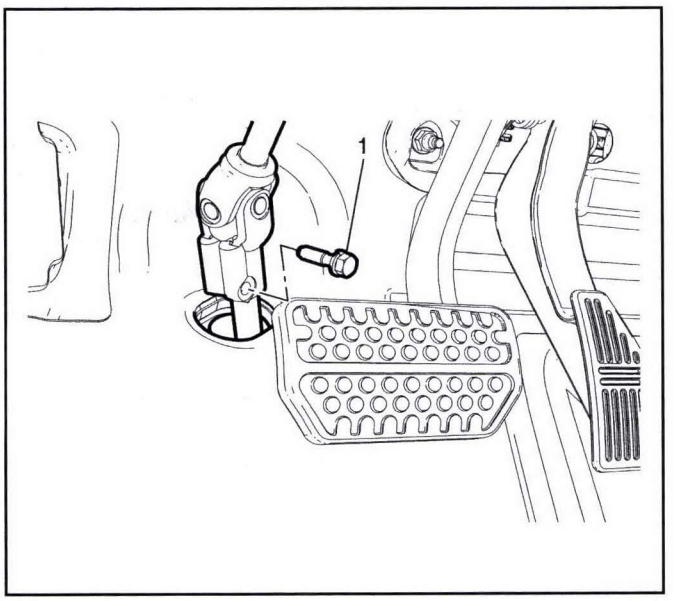
3121919

24. Connect he high voltage cable and install the high voltage cable retainer bolts (1). Refer to *Drive Motor Generator Power Inverter Module Replacement on page 9-184*.
25. Connect the range selector lever cable to the transmission. Refer to *Range Selector Lever Cable Replacement on page 16-36*.



3106897

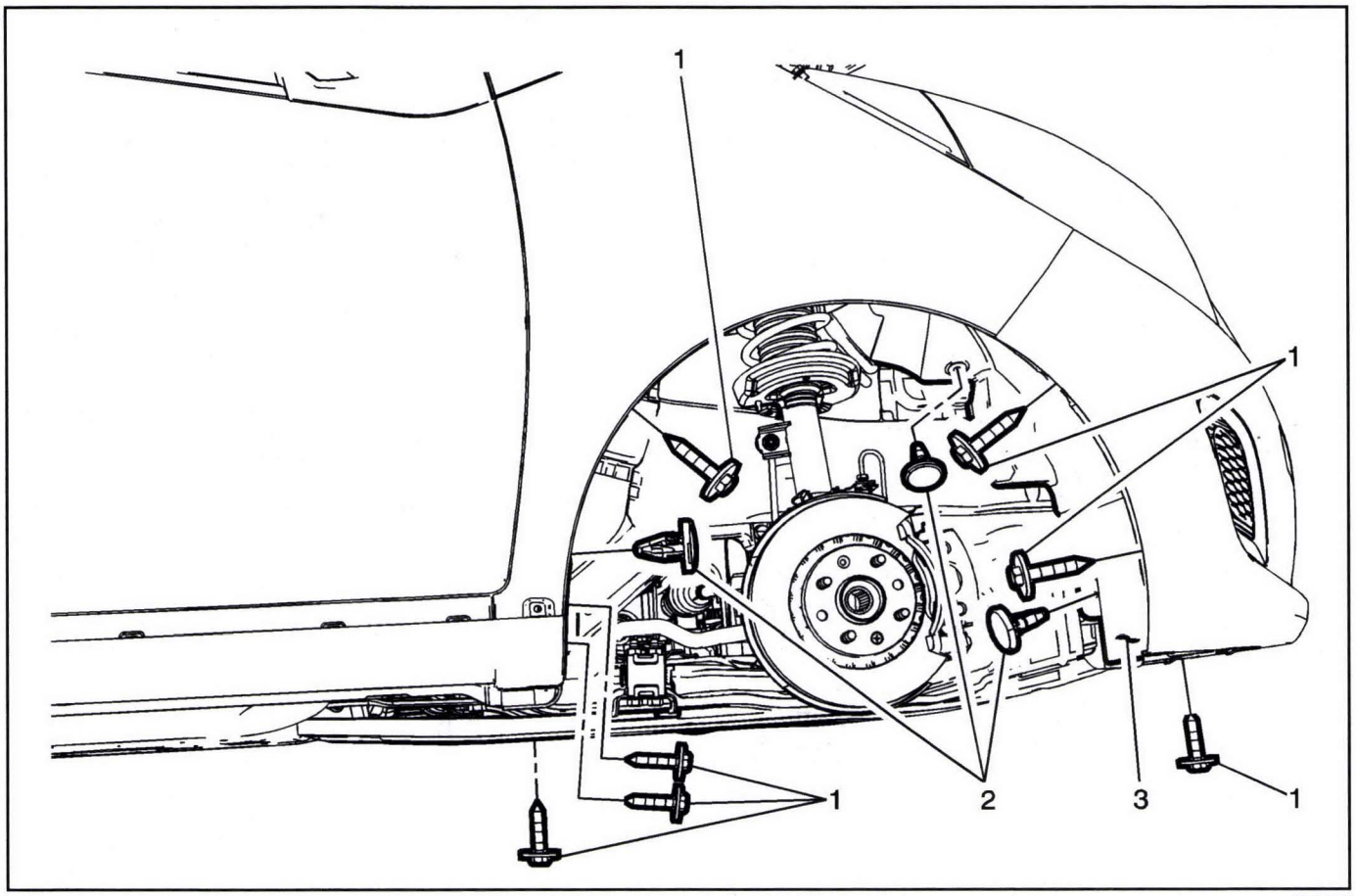
26. Unsecure the radiator cooling module (1) by removing the mechanics wire.
27. Install the front bumper lower impact bar. Refer to *Front Bumper Lower Impact Bar Replacement on page 3-56*.
28. Install the front, middle and rear portion of the front compartment splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.
29. Install the front compartment air deflector. Refer to *Front Compartment Air Deflector Replacement on page 3-125*.
30. Remove the intermediate steering shaft inner boot. Refer to *Intermediate Steering Shaft Inner Boot Replacement on page 14-27*.



2308813

31. Connect the steering intermediate shaft to the steering gear assembly. Refer to *Intermediate Steering Shaft Replacement on page 14-28*.
32. Enable the high voltage systems. Refer to *High Voltage Enabling on page 9-367*.

Front Wheelhouse Liner Replacement - Right Side

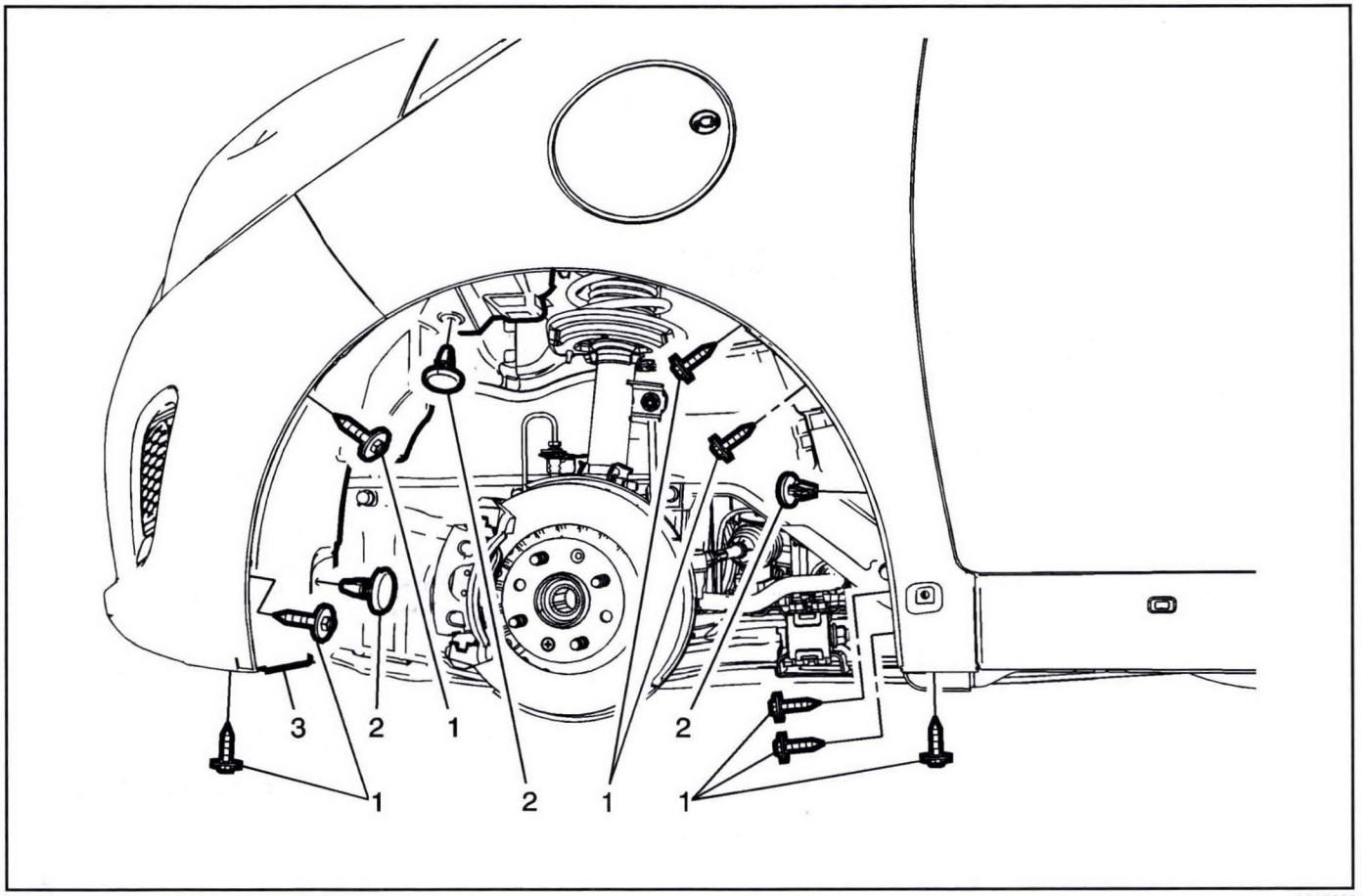


2916690

Front Wheelhouse Liner Replacement - Right Side

Callout	Component Name
Preliminary Procedure Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.	
1	Front Wheelhouse Liner Screw – Front (Qty: 7) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Front Wheelhouse Liner Push-In Retainer – Front (Qty: 3)
3	Front Wheelhouse Liner – Front

Front Wheelhouse Liner Replacement - Left Side

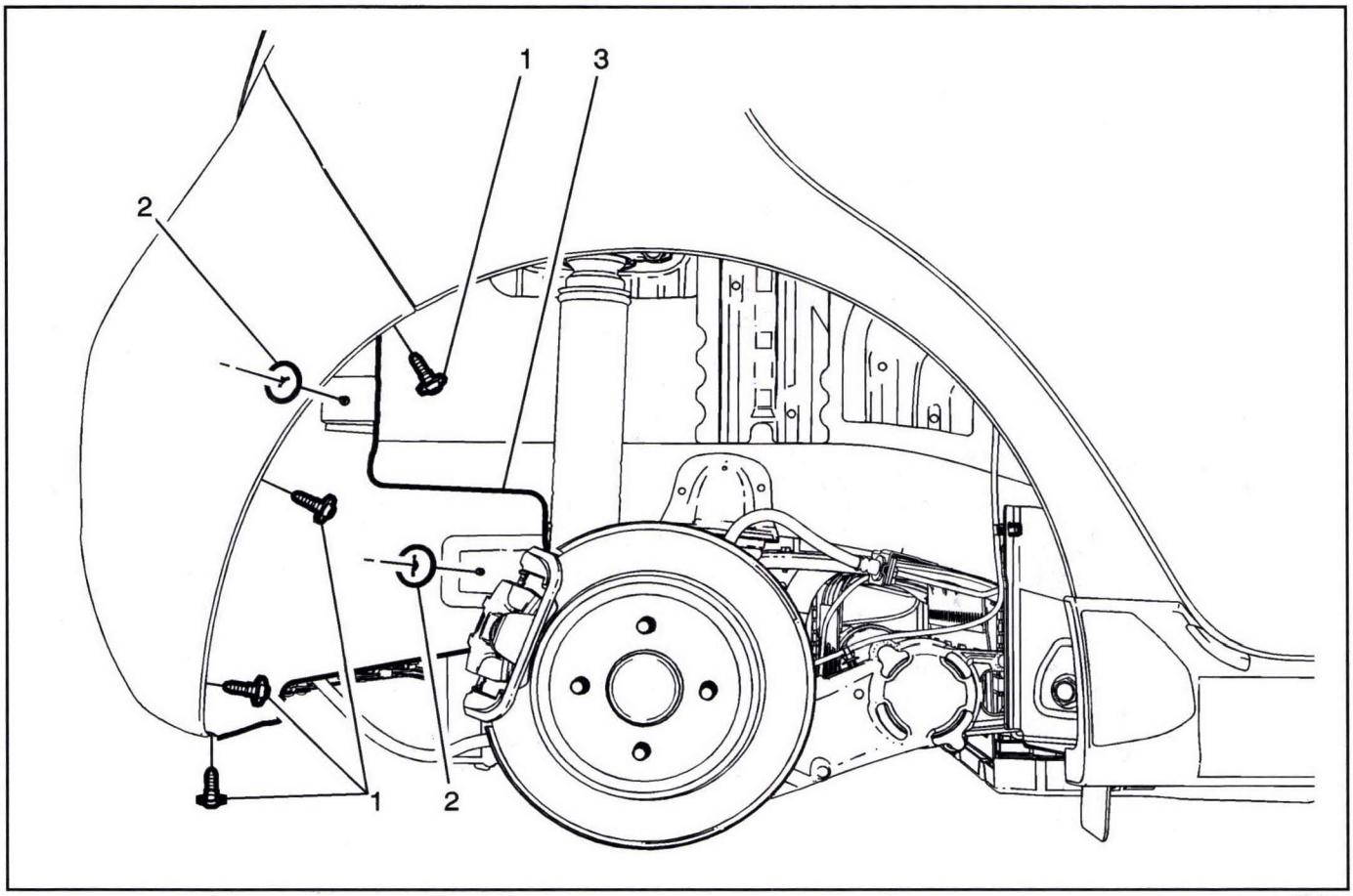


2916689

Front Wheelhouse Liner Replacement - Left Side

Callout	Component Name
Preliminary Procedure Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.	
1	Front Wheelhouse Liner Screw – Front (Qty: 8) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Front Wheelhouse Liner Push-In Retainer – Front (Qty: 3)
3	Front Wheelhouse Liner – Front

Rear Wheelhouse Liner Replacement



2964415

Rear Wheelhouse Liner Replacement

Callout	Component Name
1	Rear Wheelhouse Liner Screw (Qty: 4) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Rear Wheelhouse Liner Nut (Qty: 2) **Note:** Hand tighten only.
3	Rear Wheelhouse Liner

Paint and Coatings

Introduction

Basecoat/Clearcoat Paint Systems

Warning: Exposure to isocyanates during paint preparation and application processes can cause severe breathing problems. Read and follow all of the instructions from the manufacturers of painting materials, equipment, and protective gear.

All paint finish repairs of rigid exterior surfaces must meet GM standards. Refer to the latest revision of the GM Approved Refinish Materials book to identify the paint systems you may use that have been engineered to meet GM standards. The GM Approved Refinish Materials book supplies all approved products, including volatile organic compound (VOC) compliant regulations recommended by the individual manufacturer, and detailed procedures for materials used in their paint system.

The latest revision of the GM Approved Refinish Materials booklet is located on the Goodwrench website at www.gmgoodwrench.com.

Anti-Corrosion Treatment and Repair

Warning: When applying sound deadeners, or anti-corrosion materials due care and preventative measures must be exercised to prevent any material from being sprayed into door and quarter panel mechanisms such as door locks, window run channels, window regulators and seat belt retractors, as well as any moving or rotating mechanical or suspension parts on the underbody, particularly the parking brake cable. After material application, be sure that all body drain holes are open. Improper application may increase chance of corrosion damage or limit the operation of moving parts, resulting in personal injury.

Any procedure that disturbs these special treatments, such as panel replacement or collision damage repair operations, may leave the metal unprotected and result in corrosion. Proper recoating of these surfaces with service-type anti-corrosion material is essential.

After repair and/or replacement parts are installed, all accessible bare metal surfaces must be treated with metal conditioner and reprimed. Refer to the GM Approved Refinish Materials book which identifies the paint systems you may use.

The latest revision of the GM Approved Refinish Materials booklet is located on the Goodwrench website at www.gmgoodwrench.com.

Anti-corrosion compounds are light-bodied materials designed to penetrate between metal-to-metal surfaces, such as pinch-weld joints, hem flanges, and integral panel attaching points where metal surfaces are difficult to coat with conventional undercoating materials, and are inaccessible for painting. The materials that are suitable for interior and exterior are listed in the chart below. Conventional undercoating is recommended in order to coat large areas, such as replacement door and quarter outer panels, floor pan sections, lids, hoods, fenders, etc. During undercoating operations, care should be taken to prevent the material from being sprayed into door and quarter panel hardware mechanisms, such as door locks, window run channels, window regulators, and seat belt retractors. On the underbody, the material should not be applied to any moving or rotating part, energy absorbing bumper components, or shock absorbers. After undercoating, ensure that all body drain holes are open.

Interior Protectant

The following products are available from GM Dealer Equipment. For technical information, call 187-Permatex (1-877-376-2839):

Permatex Part Number	Description
310-JDI-UCA1	Permatex Canister and Wand Assembly
310-81881	Permatex Amber Rust Proofing (24 oz) (Qty of 12)
310-81882	Permatex Amber Rust Proofing (1 gal)

Exterior Protectants

The following product is available from *ECP, Inc. Contact them at 1-800-323-3521 or www.ecpinc.net.

Part Number	Description
178660	Nox Rust X-121B (12 cans per case)

The following products are available from your local *3M® distributor, or call 1-800-521-8180, ext. 779-5165.

3M® Part Number	Description
08804	Water-Based Undercoat
08801	No Clean-Up Applicator Gun
05917	Weld-Thru Coating
08891	Rust Fighter-I

The following product is available from *Transtar Autobody Technologies. Contact the company at 1-800-824-2843 or www.tat-co.com.

Part Number	Description
4353	Weld-Through Primer

*We believe these sources and their products to be reliable. There may be additional manufacturers of such material. General Motors does not endorse, indicate any preference for, or assume any responsibility for the products from these firms, or for any such items which may be available from other sources.

These sealers are intended to prevent water and dust from entering the vehicle and also are anti-corrosion barriers. Sealers are applied to such areas as rear compartment lid hem flanges, wheelhouse, quarter outer, floor, cowl, roof, and various other panel to panel attaching points. The originally sealed joints are obvious and any damage to these sealed locations

should be corrected by resealing. Attaching points of new replacement panels should be resealed. Replacement lids and doors will also require sealing in the hem flange areas.

Flanged joints, overlap joints, and seams should be sealed using a quality sealer of medium-bodied consistency. The sealer used must retain its flexible characteristics after curing and be paintable.

Open joints which require bridging of the sealer in order to close a gap should be sealed using a heavy-bodied caulking material. Follow the label directions for the material selected.

Color application may be required in order to restore repaired areas such as hood, fenders, doors, quarters, lid, roof, engine compartment, underbody, and inner panels to original appearance. When this is necessary, conventional refinishing preparation, undercoat buildup, and color application techniques should be followed.

Deadener materials, spray-on type, are used on various metal panels in order to provide corrosion resistance and joint sealing. They control the general noise level inside the passenger area of the vehicle. When deadeners are disturbed because of damage, are removed during repair operations, or a new replacement panel is installed, the deadener material must be replaced by a service equivalent material. The application pattern and location of deadener materials can be determined by observing the original production installation.

Cleaning of the interior and underbody panel surfaces is necessary when original galvanized or other anti-corrosion materials have been burned off during welding or heating operations. Removal of the residue from burning will require additional care in such areas as interior surfaces of box-type construction and when configurations of the metal panels limit access to interior surfaces.

Repair Instructions

Clearcoat Repair without Repainting

1. Thoroughly wash the repair area with Liquid Wash and Wax GM P/N 1052870 or the equivalent.
2. Environmental damage may be corrected. Refer to *Environmental Fallout (Acid Rain) on page 3-142* or *Rail Dust Damage Repair on page 3-143*.

   Note: Follow all of the instructions from the manufacturer of the polishing material.
3. Use a paint gauge before, during, and after sanding and/or polishing, to avoid removing too much clearcoat. Refer to *Paint Gauges on page 3-143*.

Environmental Fallout (Acid Rain)

Caution: Refer to *Clearcoat/Ultraviolet Screeners Caution on page 0-8*.

Note: Always refer to the manufacturer's packaged instructions for the detailed procedures of materials used for compounding and/or polishing.

Since the severity of the condition varies from area to area, proper diagnosis of the contamination extent is critical to the success of the repairs. Perform the diagnosis under high intensity fluorescent lighting on the horizontal surfaces (hood, roof panel, rear compartment lid), after the surfaces have been properly cleaned by washing the vehicle with GM Wash and Wax GM P/N 1237841 (Canadian P/N 10953203), or equivalent.

There are 3 basic types of acid rain damage:

Surface Level Contamination: May be repaired by simply washing the vehicle, cleaning the surface with a silicone wax and grease remover, neutralizing acidic residue, and finesse polishing. Refer to Surface Level Contamination Repair.

Clearcoat Etching: Slight etching is still noticeable after the above washing and finesse polishing procedure. Refer to Slight Clearcoat Damage – Wet Sanding, Finesse Polishing.

Basecoat Etching: Severe etching beyond the clearcoat into the basecoat in the affected areas will require refinishing. Refer to *Basecoat/Clearcoat Paint Systems on page 3-141*.

Surface Level Contamination Repair

1. Thoroughly wash and dry the contaminated area with GM Wash and Wax GM P/N 1237841 (Canadian P/N 10953203), or equivalent.
2. Clean the affected area with silicone, wax and grease remover.
3. Remove and neutralize acidic residue by cleaning the contaminated areas with a mixture of baking soda and water (1 tablespoon of baking soda per 1 liter or 1 quart of water). Rinse thoroughly and dry the panel completely.
4. Apply finesse-type polish with a foam panel. If damage has been repaired, remove any swirl marks with a dual action orbital polisher and foam pad.
5. If some damage remains, refer to Slight Clearcoat Damage – Wet Sanding, Finesse Polishing.

Slight Clearcoat Damage – Wet Sanding, Finesse Polishing

1. Select a small contaminated test area.
2. Film thickness should be taken prior to the sanding and polishing. Refer to *Paint Gauges on page 3-143*.
3. Wet sand and finesse polish the contaminated test area. If during the polishing you suspect or observe that etching has penetrated into the basecoat, too much clearcoat has been removed during sanding, or base color is transferred to the polishing pad during polishing, then the affected areas will require refinishing. Refer to *Basecoat/Clearcoat Paint Systems on page 3-141*.

Paint Gauges

Paint thickness gauges measure the total thickness of the vehicle finish. It is important to accurately measure the thickness of the finish on each vehicle as the thickness of the finish will vary on each vehicle. Use a paint gauge before the sanding process in order to accurately measure how much finish there is to remove before, during, and after the sanding process. Paint gauges range from magnetic pull type to sophisticated electronic types, and are available from a variety of sources. The older magnetic type gauges, at best have a 5 percent accuracy range and are not sensitive enough to detect removal of 0.02 mm 0.5 mil (0.0005 in) clearcoat. The newer type magnetic gauges have improved accuracy ranges. Most gauges are confined to checking either ferrous metal, steel, non-ferrous metal, or aluminum panel. At this time, there are no viable gauges for reading film thickness on composite (SCM doors, RIM fenders) panels. The more sophisticated electronic paint thickness gauges (ETG) digital type gauges are able to read film thickness on both ferrous and non-ferrous metal panel. Digital ETG gauges may have an accuracy range of 1 percent and include thickness standards for recalibration. The following paint thickness gauges are available. Call 1-800-GM-TOOLS for information:

Paint Thickness Gauges

- 147-5437-ETG Standard model
- 147-5437-ETG-P Standard model with print option
- 147-5437-N-ETG-N Non-ferrous model for aluminum panels
- 147-5437-NP-ETG-NP Non-ferrous model with print option
- 147-54437-SD-ETG Steel and aluminum gauge

Clearcoat Thickness

The clearcoat on the vehicle is typically 0.059–0.078 mm (1.5–2 mils [0.0015–0.0020 in]) thick. The clearcoat contains ultraviolet screeners. Removing more than 0.5 mils (0.019 in) of the clearcoat may result in early paint failure.

Rail Dust Damage Repair

Warning: Refer to Eye Protection Warning on page 0-4.

Note: If rail dust has penetrated into the basecoat, the panel requires refinishing. Ensure all the rail dust has been removed prior to refinishing or the rust spots will return.

Rail dust damage comes from the tiny iron particles produced from the friction between the train wheels and the track. It can also be deposited on vehicles if stored near any operation producing iron dust (i.e., steel ore yards). This dust can either lay on top of, or embed into the paint surface. It is usually diagnosed as bumps in the paint surface or rust colored spots in the paint.

1. Move the vehicle to a cool shaded area and ensure the vehicle surfaces are cool during the removal process.
2. Thoroughly wash the repair area with Liquid Wash and Wax GM P/N 1052870, or equivalent.
3. Wipe the area dry.
4. Clean the affected area with silicone, wax and grease remover.
5. Perform the removal process according to the manufacturer's directions of the type of repair material used (Gel Type Oxalic Acid or Clay Type Non-Acid Based). If, upon inspection, some particles are still present, the process may be repeated. If the damage has been repaired, complete the repair to the entire panel.
6. Polish the entire panel after the removal process. If small pits remain in the clearcoat after all of the damage has been repaired, refer to *Clearcoat Repair without Repainting on page 3-142*.

Plastic Panel Information and Repair

Repair Instructions

General Plastic Repair

Warning: In order to reduce the risk of personal injury when exposed to toxic fumes while grinding, cutting, or applying repair material on any type of sheet molded compound or RIM rigid plastic, observe the following guidelines:

- ***Work in a properly ventilated area***
- ***Apply protective cream to any exposed skin***
- ***Remove any mixture that comes into contact with skin***
- ***Wash skin with cold water to remove glass and resin dust***
- ***Use a sander with a vacuum attachment***
- ***Follow the repair material manufacturer's instructions***

Also, always wear the following:

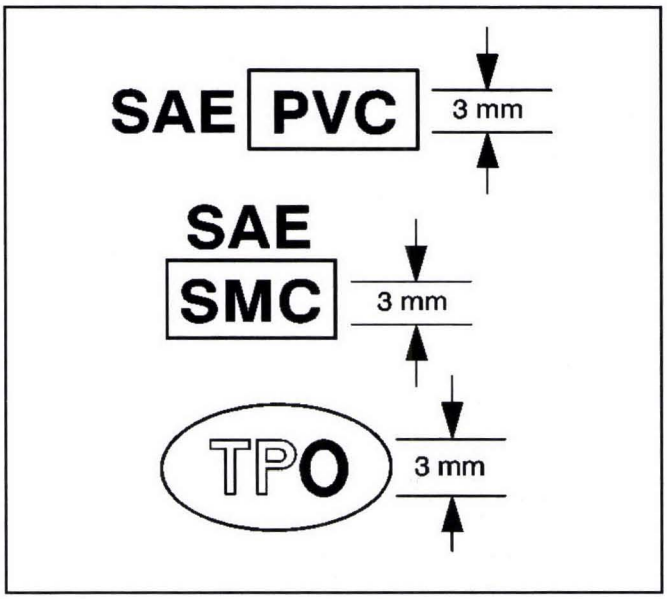
- ***An approved respirator, or air supplied respirator***
- ***Eye protection***
- ***Rubber gloves***
- ***Earplugs***
- ***Protective clothing***

The following procedures should be followed when repairing all types of thermoset plastic:

- Follow the manufacturer's application and curing recommendations.
- Do not intermix systems. Use the supplies and the repair materials from the same manufacturer.
- Clean the inner and outer surfaces of the repair area with a soap impregnated scouring pad in order to remove any dirt or mold release agent.
- Clean the area with a wax and grease remover, using only enough of the remover to dampen a cloth. Allow the panel to dry thoroughly.
- Remove the surface finish from the area to be repaired. Adhesives are designed to adhere to the plastic substrate, not the finish.
- Prime a metal surface before applying the repair material.
- Inspect the rear side of the work area before making repairs in order to avoid possible damage to wires, motors, etc.

Description and Operation

How to Identify Plastic Parts



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Plastic parts can be identified by the SAE code, which is usually found on the rear of the part, and/or by the characteristics of the plastic. Knowing the type of plastic aids in selecting the proper repair materials and in selecting the proper repair procedure.

Look for the SAE code stamped into the part.

Code Found

Match the code to those in the plastic identification chart to determine whether the plastic is thermoplastic or thermoset plastic, and whether the plastic is rigid or flexible. Refer to *Plastic Identification and Refinishing Systems on page 3-145*.

No Code Found

Warning: Do NOT use a plastic burn test to distinguish the type of plastic. The burn test produces vapors which are harmful.

Perform one or both of the following tests to determine if the part is thermoplastic polyolefin or thermoset non-polyolefin.

Float Test

1. Cut a shaving of plastic from the back of the part.
   The shaving should be free of mold release agents and paint.
2. Place the shaving in a container of water.
   - Thermoplastic polyolefin floats
   - Thermoset non-polyolefin sinks

Abrasion Test

- Sand a spot near the damaged area with Grade36 Roloc Disc.
- Thermoplastic polyolefin material melts or frays when sanded.
- Thermoset non-polyolefin material sands cleanly.

Thermoplastic and thermoset plastics can be either rigid or flexible. Thermoplastic plastic parts are best repaired with a hot iron plastic material-feed welder, but are usually replaced. Thermoset plastic can be repaired with epoxy or other more rigid 2 package repair material.

For general repair instructions, refer to *General Plastic Repair on page 3-144*.

Plastic Identification and Refinishing Systems

Identifying Symbol – Old Symbol in ( )s	Chemical Composition or Plastic Family Name	Typical Area(s) Where Part is Used	Examples of Common/ Trade Names	Type of Plastic
ABS	Acrylonitrile/ Butadiene-Styrene	Armrest Support, Console, IPC, Steering Column Bracket/ Jacket, Trim Molding	ABS, Absafil, Magnum, Cycolac, Dyel, Kralastic, Lustran	Thermoplastic
ABS + PC	Acrylonitrile / Butadiene-Styrene + Polycarbonate	Instrument Panel, IPC	Bayblend, Cycoloy, KHA, Pulse	Rigid
ABS/PVC	ABS/Vinyl (Soft)	Head Rest Cover, Instrument Panel Pad, Trim Molding/ Panel	ABS Vinyl	Flexible, Vinyl
EPDM	Ethylene Propylene Diene Monomer	Body Panel, Bumper Impact Strip	EPDM, Nordel	Rigid
EVA (EVAC)	Ethylene / Vinyl Acetate	Head Rest Cover, Misc Soft Trim	Elvax, Microthane	Flexible
PA	Polyamide	Headlamp Bezels, Quarter Panel Extensions, Exterior Finish Trim Panels	Nylon, Capron, Zytel, Rilsan, Minion, Vydyne, Welland	Rigid
PA, PAG, PAGG	Polyamide	Exterior Finish Trim Panel, Headlamp Bezel, Quarter Panel Extension	Capron, Minlon, Nylon, Rilsan, Vydyne, Wellamid, Zytel	Rigid, Thermoset
PA + PPE	Polymide + Polypheneylene Ether	Exterior Trim, Fender	GTX	Rigid, Thermoset
PBT + TEEE (PBTP + EEBC)	Polybutylene, Terephthalate + Ether, Ester Block Compound	Fascia, Rocker Panel Molding	Bexloy M	Rigid
PC	Polycarbonate	Interior Rigid/Hard Trim Panel, Valance Panel	Calibre, Lexan, Merlon, Makrolon	Rigid, Thermoset
PC + PETP	Polycarbonate + Polybutylene, Terephthalate	Bumper Fascia	Macroblend, Valox, Xenoy	Flexible, Thermoset
PE	Polyethylene	Fuel Tank Shield, Inner Fender Panel, Interior Trim Panel, Seat Belt Cover, Spoiler, Valance	Alathon, Dylan, Foriflex, Hi-fax, Hosalen, Marlex, Paxon	Rigid, Thermoplastic
PF	Phenol Formaldehyde	Ashtray	Amberol, Bakelite, Durez, Genal, Phenolic, Plyophen, Resinox	Rigid, Thermoset

Plastic Identification and Refinishing Systems (cont'd)

Identifying Symbol – Old Symbol in ( )s	Chemical Composition or Plastic Family Name	Typical Area(s) Where Part is Used	Examples of Common/ Trade Names	Type of Plastic
PP	Polypropylene	Bumper Fascia, Cowl Panel, Deflector Panel, Door Panel, Inner Fender, Interior Molding, Kick Panel, Load Floor, Radiator Shroud, Wheel Cover	Azdel, Daplen, Escorene, Marlex, Novolen, Oleflo, Profax, Tenite	Flexible, Thermoplastic
PPE (PPO)	Polyphenylene Ether	Bezels, Chromed Plastic, Headlamp Door, Ornaments	Noryl, Oleflo, Prevex	Rigid, Thermoset
PS	Polystyrene	Dash Panel, Door Panel	Durathon, Dylan, Lustrex, Polystyrol, Styron	Flexible, Soft
PUR	Polyurethane, Thermoset (Unsaturated)	Bumper Fascia, Filler Panel, Front/ Rear Body Panel, Pickup Box	Bayflex, Castethane, RIM, RRIM, SRIM	Thermoset
PVC	Polyvinyl Chloride (Vinyl)	Interior Soft Trim, I/P Skins, Roof Cover	Geon, Pliovic, Unichem, Vinoflex, Vinyl, Vinylite	Flexible, Vinyl
SAN (SA)	Styrene Acrylonitrite	Center Console, Glove Box Door, Interior Trim Panel	Foracryl, Lustran, Tyril	Rigid
TEO (EP, EPM, TPO)	Ethylene / Propylene (Rubber)	Air Dam, Bumper Fascia, Valance Panel	EPI, EPII, TPO, TPR (Thermoplastic Rubber)	Flexible, Thermoplastic
TPO	Thermal Plastic Oletin	Bumper Covers	TPO	Flexible Thermoplastic
TPU (TPUR)	Polyurethane, Polyolefin	Bumper Fascia, Gravel Deflector, Soft Filler Panel, Window Molding	Estane, Pellethane, Roylar, Toxin	Flexible, Thermoplastic
UP	Polyester / Thermoset	Air Scoop, Air Spoiler, Fascia Extension, Hood, Instrument Housing, Rear Compartment Lid, Roof, Ventilation Grid	Fiberglass, Premi-glass, Selectron, SMC, Vibrinmat	Rigid, Thermoset
For symbols not listed in this table, contact the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001.				

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BLANK

Fixed and Moveable Windows

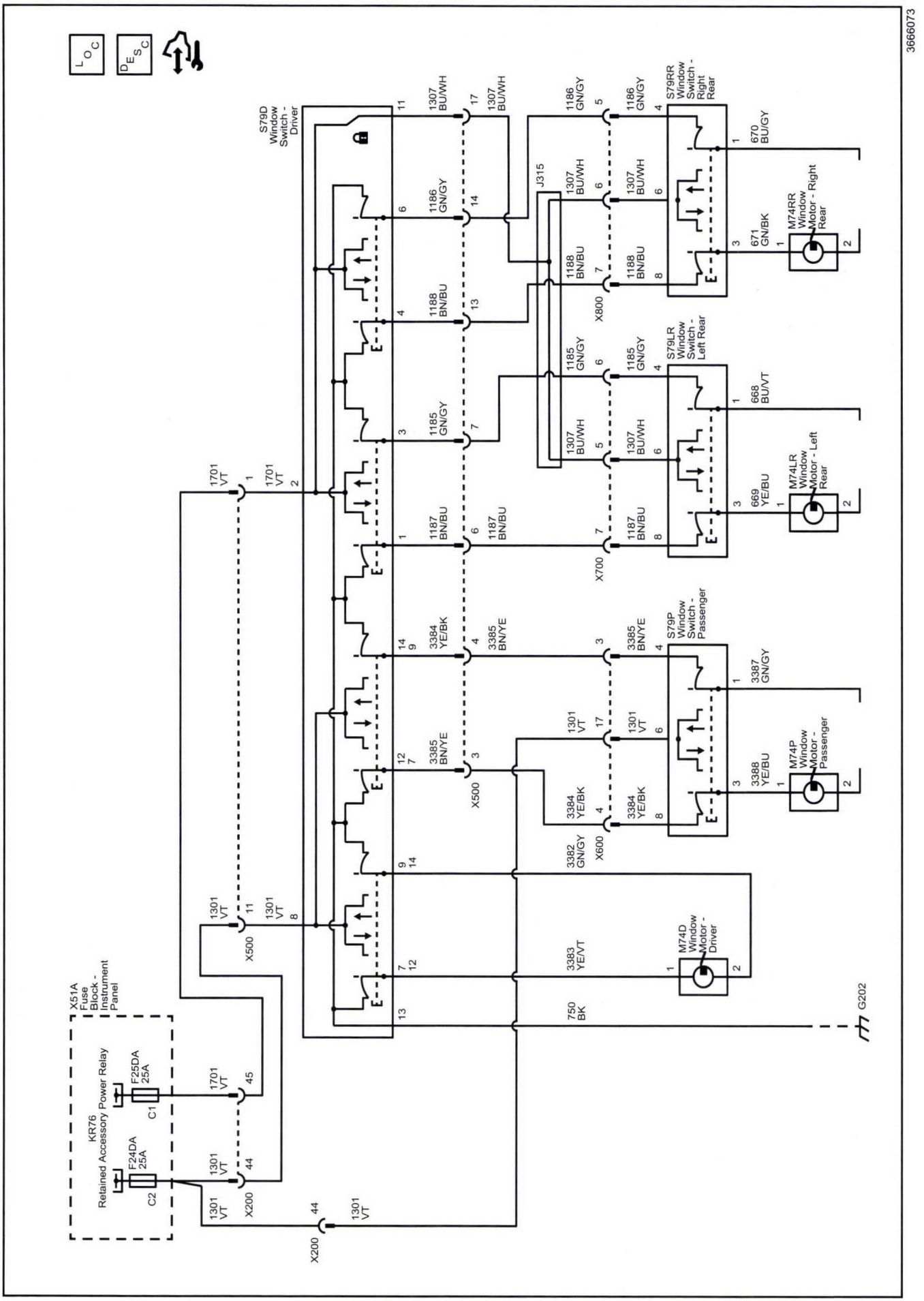
Specifications

Fastener Tightening Specifications

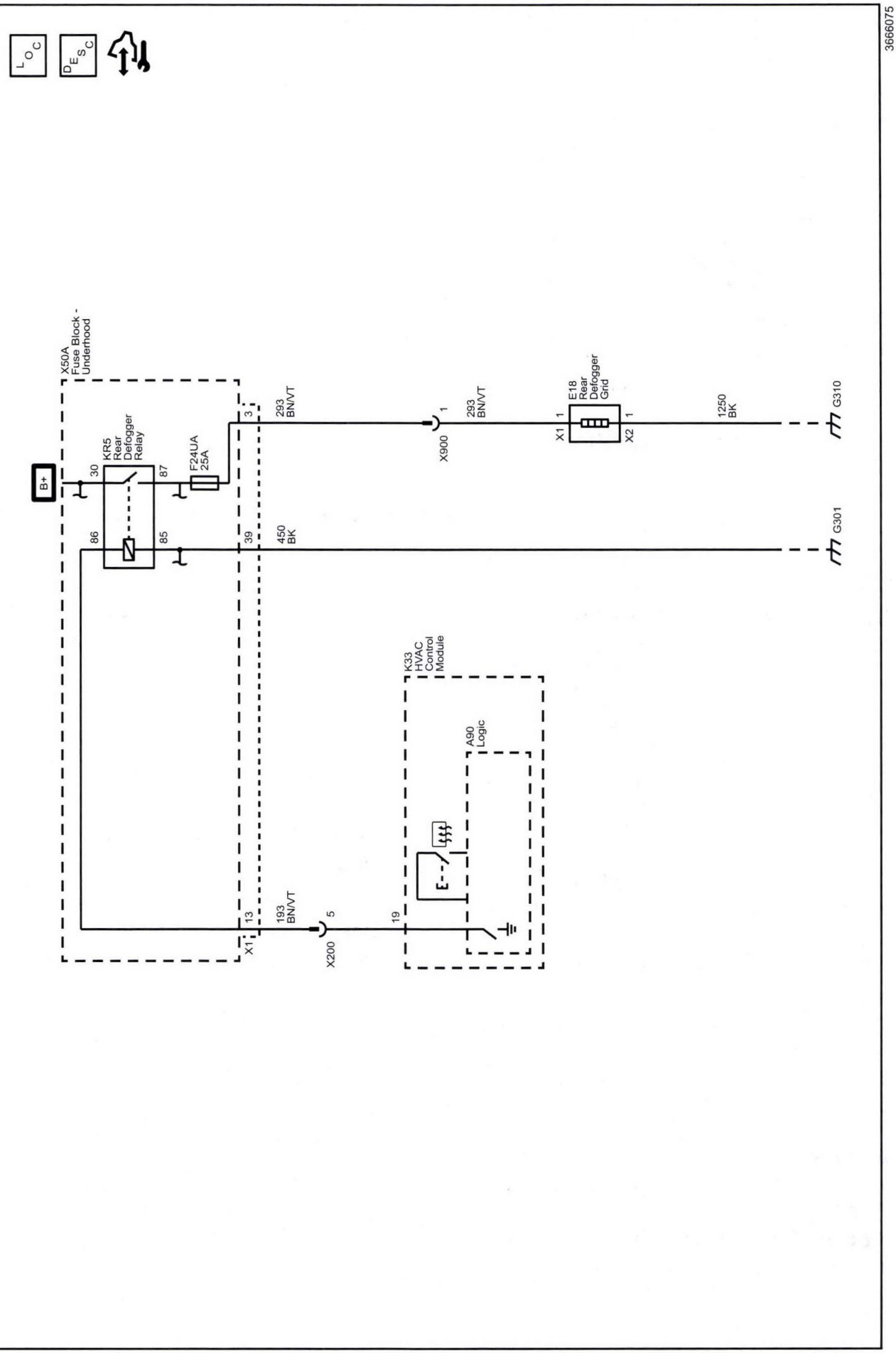
Application	Specification	
	Metric	English
Front Side Door Window Outer Sealing Strip Screw	2 N•m	18 lb in
Front Side Door Window Rear Guide Nuts	11 N•m	97 lb in
Front Side Door Window Regulator Nuts	8 N•m	71 lb in
Front Side Door Window Regulator Sash Screws	2 N•m	18 lb in
Rear Side Door Window Outer Sealing Strip Screw	2 N•m	18 lb in
Rear Side Door Window Rear Guide Nuts	11 N•m	97 lb in
Rear Side Door Window Regulator Nuts	8 N•m	71 lb in
Rear Side Door Window Regulator Sash Screws	2 N•m	18 lb in

Schematic and Routing Diagrams

Moveable Window Schematics (Front and Rear Power Windows)



Defogger Schematics (Rear Window Defogger)



Diagnostic Information and Procedures

DTC B0283

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B0283: Rear Defrost Circuit

For symptom byte information refer to: *Symptom Byte List on page 6-117*

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	B0283 02	B0283 04	B0283 01	—
Ground	—	B0283 04	—	—

Circuit/System Description

Battery positive voltage is supplied through a 20A fuse in the underhood fuse block to the rear defogger relay switched input. When the rear window defogger switch is pressed, the body control module commands the rear window defogger system by supplying voltage to the rear defogger relay coil. The rear defogger relay is energized and the defogger indicator is illuminated. With the relay energized, battery positive voltage is allowed from the relay switched input through the switch contacts and out the relay switched output to the rear window defogger grid.

Conditions for Running the DTC

When the relay is being actively commanded by the body control module

Conditions for Setting the DTC

B0283 01

The body control module detects a short to voltage in the relay control circuit.

B0283 02

The body control module detects a short to ground in the relay control circuit.

B0283 04

The body control module detects an open/high resistance in the relay control circuit.

Action Taken When the DTC Sets

The body control module will attempt to command the rear defog relay, but the rear window defogger grid will remain inoperative.

Conditions for Clearing the DTC

- The DTC will be current for as long as the fault is present.
- When the fault is no longer present, the DTC will be a history DTC.
- A history DTC will clear after 50 ignition cycles.

Reference Information

Schematic Reference

Defogger Schematics on page 4-7

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Rear Window Defogger Description and Operation on page 4-53

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Engine Running.
2. Verify the E18 Rear Defogger Grid turns ON and OFF when commanding the Rear Defogger Active and Inactive with a scan tool.

⇒ **If the E18 Rear Defogger Grid does not turn ON or OFF**

Refer to Circuit/System Testing

⇓ **If the E18 Rear Defogger Grid turns ON and OFF**

3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the KR5 Rear Defogger Relay. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 85 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Connect a test lamp between the control circuit terminal 86 and the ground circuit terminal 85, Engine Running.
4. Verify the test lamp turns ON and OFF when commanding the Rear Defogger Active and Inactive with a scan tool.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

4.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, Engine Running.

4.2. Test for less than 1 V between the control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

5. Test or replace the KR5 Rear Defogger Relay.

Component Testing

Relay Test

1. Vehicle OFF, disconnect the KR5 Rear Defogger Relay.
2. Test for 60-180 Ω between terminals 85 and 86.

⇒ **If less than 60 Ω or greater than 180 Ω**

Replace the KR5 Rear Defogger Relay.

⇓ **If between 60-180 Ω**

3. Test for infinite resistance between the terminals listed below:
   - 30 and 86
   - 30 and 87
   - 30 and 85
   - 85 and 87

⇒ **If less than infinite resistance**

Replace the KR5 Rear Defogger Relay.

⇓ **If infinite resistance**

4. Install a 3 A fused jumper wire between relay terminal 85 and 12 V. Install a jumper wire between relay terminal 86 and ground.
5. Test for less than 2 Ω between terminals 30 and 87.

⇒ **If 2 Ω or greater**

Replace the KR5 Rear Defogger Relay.

⇓ **If less than 2 Ω**

6. All OK

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Relay Replacement (Within an Electrical Center) on page 11-953* or *Relay Replacement (Attached to Wire Harness) on page 11-953*
- *Control Module References on page 6-3* for the body control module replacement, programming and setup

Symptoms - Fixed and Moveable Windows

Important Preliminary Checks Before Starting:

1. Perform the *Diagnostic System Check - Vehicle on page 6-91* before using the symptom tables in order to verify that all of the following are true:
   - There are no DTCs set.
   - The control modules can communicate via the serial data link.
2. Review the power window system operation or rear window defogger system operation in order to familiarize yourself with the system functions. Refer to the following:
   - *Rear Window Defogger Description and Operation on page 4-53*
   - *Power Windows Description and Operation on page 4-51*

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the rear window defogger. Refer to *Checking Aftermarket Accessories on page 11-871*.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Note:

- Inspect for proper installation of electrical components if an intermittent condition exists. Inspect for aftermarket theft deterrent devices, lights, and cellular phones. Ensure that no aftermarket equipment is connected to the class 2 circuit. If you can not locate an intermittent condition, a cellular phone signal may cause the condition. Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to *Testing for Intermittent Conditions and Poor Connections on page 11-877*.
- The problem may or may not turn ON the SERVICE VEHICLE SOON indicator or store a DTC. Do not use the symptom tables to diagnose intermittent conditions. The malfunction must be present in order to locate the problem.

Poor electrical connections or wiring cause most intermittent conditions. Perform a careful visual/physical check for the following conditions:

- Poor mating of the connector halves or a terminal not fully seated in the connector body
- An improperly formed or damaged terminal
- Reform or replace connector terminals in the problem circuit in order to ensure proper contact tension.
- Poor terminal to wire connection requires removing the terminal from the connector body in order to perform the check.

Use a scan tool in order to help detect intermittent conditions. The scan tool has several features that can be used to locate an intermittent condition. The snapshot feature can capture and store data parameters within the scan tool when the malfunction occurs. This information can then be reviewed in order to see what caused the malfunction.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- *Rear Window Defogger Malfunction on page 4-10*
- *Power Windows Malfunction (With A32) on page 4-13* or *Power Windows Malfunction (With AE3) on page 4-18*

Rear Window Defogger Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay B+	1	1	—	—

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Rear Defog Switch Signal	2	1	1	—
Relay Control	B0283 02	B0283 04	B0283 01	—
Rear Defogger Grid Control	1	1	2	—
Relay Ground	—	B0283 04	—	—
Rear Defogger Grid Ground	—	1	—	—
1. Rear Defogger Grid Inoperative 2. Rear Defogger Grid Always ON				

Circuit/System Description

Battery positive voltage is supplied through a 30A fuse in the underhood fuse block, to the rear defogger relay switched input. When the rear window defogger switch is pressed, The HVAC control module commands the rear window defogger system by supplying voltage to the rear defogger relay coil. The rear defogger relay is energized and the defogger indicator is illuminated. With the relay energized, battery positive voltage is allowed from the relay switched input through the switch contacts and out the relay switched output to the rear window defogger grid.

Reference Information

Schematic Reference

Defogger Schematics on page 4-7

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Rear Window Defogger Description and Operation on page 4-53

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode
2. Verify the E18 Rear Defogger Grid turns ON and OFF pressing the rear window defogger switch.

⇒ **If the E18 Rear Defogger Grid does not turn ON and OFF**

Refer to Circuit/System Testing

⇓ **If the E18 Rear Defogger Grid turns ON and OFF**

3. Verify the rear window defogger indicator turns ON and OFF when commanding the Illuminate All Indicators On and Off with a scan tool.

⇒ **If the rear window defogger indicator does not turn ON and OFF**

Replace the K33 HVAC Control Module.

⇓ **If the rear window defogger indicator turns ON and OFF**

4. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the KR5 Rear Defogger Relay. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 85 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.

⇒ **If the test lamp does not illuminate**

Replace the X50A Fuse Block-Underhood

⇓ **If the test lamp illuminates**

5. Connect a test lamp between the control circuit terminal 86 and the ground circuit terminal 85.

6. Verify the test lamp turns ON and OFF pressing the rear window defogger switch.

⇒ **If the test lamp is always OFF**

6.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K33 HVAC Control Module.

6.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

6.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K33 HVAC Control Module.

⇒ **If the test lamp is always ON**

6.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K33 HVAC Control Module, Vehicle in Service Mode.

6.2. Test for less than 1 V between the control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

7. Verify that a test lamp does not illuminate between the control circuit terminal 87 and ground.

⇒ **If the test lamp illuminates**

Repair the short to voltage on the control circuit

⇓ **If the test lamp does not illuminate**

8. Vehicle OFF and all vehicle systems OFF, disconnect the X2 harness connector at the E18 Rear Defogger Grid. It may take up to 2 minutes for all vehicle systems to power down.
9. Test for less than 10 Ω between the ground circuit terminal 1 and ground.

⇒ **If 10 Ω or greater**

9.1. Vehicle OFF.

9.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

10. Connect the X2 harness connector at the E18 Rear Defogger Grid.
11. Vehicle in Service Mode, connect a 20 A fused jumper wire between the B+ circuit terminal 30 and the control circuit terminal 87.
12. Verify the E18 Rear Defogger Grid is activated.

⇒ **If the E18 Rear Defogger Grid does not activate**

12.1. Vehicle OFF, remove the jumper wire, disconnect the X1 harness connector at the E18 Rear Defogger Grid.

12.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

12.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the E18 Rear Defogger Grid.

⇓ **If the E18 Rear Defogger Grid activates**

13. Test or replace the KR5 Rear Defogger Relay.

Component Testing

Relay Test

1. Vehicle OFF, disconnect the KR5 Rear Defogger Relay.
2. Test for 60–180 Ω between terminals 85 and 86.

⇒ **If less than 60 Ω or greater than 180 Ω**

Replace the KR5 Rear Defogger Relay.

⇓ **If between 60-180 Ω**

3. Test for infinite resistance between the terminals listed below:
   - 30 and 86
   - 30 and 87
   - 30 and 85
   - 85 and 87

⇒ **If less than infinite resistance**

Replace the KR5 Rear Defogger Relay.

⇓ **If infinite resistance**

4. Install a 3 A fused jumper wire between relay terminal 85 and 12 V. Install a jumper wire between relay terminal 86 and ground.
5. Test for less than 2 Ω between terminals 30 and 87.

⇒ **If 2 Ω or greater**

Replace the KR5 Rear Defogger Relay.

⇓ **If less than 2 Ω**

6. All OK

Rear Defogger Grid Test

Note: Lightly touch the grid lines when testing with the test lamp. If the test lamp point is scraped through the grid line it can cause an open in the circuit

1. Engine running, command the Rear Defogger ON by pressing the rear window defogger switch.
2. Verify that a test lamp illuminates between each rear window defogger grid line and ground. The test lamp should be off when testing at the ground side of the grid and get brighter as the test lamp

moves closer to the voltage supply side of the grid. The test lamp should be dim when testing each grid line in the middle

⇒ **If the test lamp remains bright at the middle of the grid line.**

The grid line is open between the test point and the ground side of the grid.

Replace the rear window

⇒ **If the test lamp remains off at the middle of the grid line.**

The grid line is open between the test point and the voltage supply side of the grid.

Replace the rear window

⇓ **If the test lamp remains dim at the middle of each grid line.**

3. All OK

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Relay Replacement (Within an Electrical Center) on page 11-953* or *Relay Replacement (Attached to Wire Harness) on page 11-953*
- *Liftgate Window Replacement on page 4-32*
- *Control Module References on page 6-3* for the HVAC control module replacement, programming and setup

Power Windows Malfunction (With A32)

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Driver Window Switch Ignition	5	2	—	—
Driver Window Switch Ground	—	5	—	—
Driver Window Motor Control	5	1	1	—
Passenger Window Switch Ignition	5	3	—	—
Passenger Window Switch Signal	5	4	4	—
Passenger Window Motor Control	5	4	4	—

1. Driver Window Inoperative
2. Driver and Passenger Window Inoperative From Driver Window Switch
3. Passenger Window Inoperative from The Passenger Window Switch
4. Passenger Window Inoperative from Both Window Switches
5. Both Driver and Passenger Windows Inoperative

Circuit/System Description

The power window system will operate any time the ignition is the ACC or RUN position. The driver power window switch contains individual window switches for the passenger power window. Both windows may be controlled up and down from the driver power window switch. The passenger power window switches will only control the up and down operation of the passenger power window.

Each power window contains a reversible power window motor. The direction the window travels is dependent upon the polarity of the supply voltage. By reversing polarity of the supply voltage the window motor will move up or down. Each power window motor is internally circuit breaker protected.

Battery voltage is supplied to the power window switch through the ignition voltage supply circuit. The power window switch also receives a constant ground source. The power window motor control circuits are connected to ground through the normally closed up and down contacts of the power window switch. When the power switch is placed in the down position, the power window motor down control circuit is switched to 12 V and is applied to the down side of the power window motor. Since the other side of the power motor is connected to

ground through the normally closed contacts of the up switch, the window travels down. By placing the power window switch in the up position, the polarity of the power window motor is reversed and the window travels up.

Reference Information

Schematic Reference

Moveable Window Schematics on page 4-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Power Windows Description and Operation on page 4-51

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the driver window performs the UP and DOWN functions.

⇒ **If the driver window does not perform the UP or DOWN functions**

Refer to Circuit/System Testing – Driver Window Inoperative

⇓ **If the driver window performs the UP and DOWN functions**

3. Verify the M74P Window Motor-Passenger performs the UP and DOWN functions at both the S79D Window Switch-Driver and S79P Window Switch-Passenger.

⇒ **If the M74P Window Motor-Passenger is inoperative from both the S79D Window Switch-Driver and S79P Window Switch-Passenger**

Refer to Circuit/System Testing − Passenger Window Inoperative From Both Switches.

⇒ **If the M74P Window Motor-Passenger is inoperative from the passenger window switch only**

Refer to Circuit/System Testing – Passenger Window Switch Inoperative.

⇒ **If the M74P Window Motor-Passenger is inoperative from the S79D Window Switch-Driver only**

Test or replace the S79D Window Switch-Driver.

⇓ **If the M74P Window Motor-Passenger performs the UP and DOWN functions at both switches**

4. All OK.

Circuit/System Testing

Driver Window Inoperative

1. Vehicle OFF, disconnect the harness connector at the S79D Window Switch-Driver. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the ignition circuit terminal 6 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

4.1. Vehicle OFF.

4.2. Test for less than 2 Ω in the ignition circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, refer to *Retained Accessory Power Malfunction on page 11-863*.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

4.1. Vehicle OFF.

4.2. Test for infinite resistance between the ignition circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for infinite resistance between the control circuits listed below and ground:

- Control circuit terminal 1
- Control circuit terminal 2
- Control circuit terminal 4
- Control circuit terminal 5

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the S79D Window Switch-Driver.

⇓ **If the test lamp illuminates**

5. Vehicle OFF, connect the harness connector at the S79D Window Switch-Driver and disconnect the harness connector at the M74D Window Motor-Driver. It may take up to 2 minutes for all vehicle systems to power down.

6. Test for less than 10 Ω between the control circuit terminal 1 and ground.

⇒ **If 10 Ω or greater**

6.1. Vehicle OFF, disconnect the harness connector at the S79D Window Switch-Driver.

6.2. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the S79D Window Switch-Driver.

⇓ **If less than 10 Ω**

7. Test for less than 10 Ω between the control circuit terminal 2 and ground.

⇒ **If 10 Ω or greater**

7.1. Vehicle OFF, disconnect the harness connector at the S79D Window Switch-Driver.

7.2. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the S79D Window Switch-Driver.

⇓ **If less than 10 Ω**

8. Connect a test lamp between the control circuit terminal 1 and control circuit terminal 2, Vehicle in Service Mode.

9. Verify the test lamp turns ON when commanding the UP and DOWN states with the S79D Window Switch-Driver.

⇒ **If the test lamp remains OFF during either of the commands**

9.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver.

9.2. Test for infinite resistance between each control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

9.3. Test for less than 2 Ω in each control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the S79D Window Switch-Driver.

⇒ **If the test lamp is always ON**

9.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver, Vehicle in Service Mode.

9.2. Test for less than 1 V between each control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, test or replace the S79D Window Switch-Driver

⇓ **If the test lamp turns ON during each of the commands**

10. Test or replace the M74D Window Motor-Driver.

Passenger Window Inoperative From Both Switches

1. Vehicle OFF, disconnect the harness connector at the S79P Window Switch-Passenger. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 10 Ω between the control circuit terminal 4 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF, disconnect the harness connector at the S79D Window Switch-Driver.

2.2. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the S79D Window Switch-Driver.

⇓ **If less than 10 Ω**

3. Test for less than 10 Ω between the control circuit terminal 8 and ground.

⇒ **If 10 Ω or greater**

3.1. Vehicle OFF, disconnect the harness connector at the S79D Window Switch-Driver.

3.2. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the S79D Window Switch-Driver.

⇓ **If less than 10 Ω**

4. Connect a test lamp between the control circuit terminal 4 and control circuit terminal 8, Vehicle in Service Mode.

5. Verify the test lamp turns ON when commanding the UP and DOWN functions with the S79D Window Switch-Driver.

⇒ **If the test lamp remains OFF during either of the commands**

5.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver.

5.2. Test for infinite resistance between each control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

5.3. Test for less than 2 Ω in each control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the S79D Window Switch-Driver.

⇒ **If the test lamp is always ON**

5.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver, Vehicle in Service Mode.

5.2. Test for less than 1 V between each control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, test or replace the S79D Window Switch-Driver

⇓ **If the test lamp turns ON during each of the commands**

6. Vehicle OFF, connect the harness connector at the S79P Window Switch-Passenger and disconnect the harness connector at the M74P Window Motor-Passenger. It may take up to 2 minutes for all vehicle systems to power down.
7. Test for less than 10 Ω between the control circuit terminal 1 and ground.

⇒ **If 10 Ω or greater**

7.1. Vehicle OFF, disconnect the harness connector at the S79P Window Switch-Passenger.

7.2. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the S79P Window Switch-Passenger.

⇓ **If less than 10 Ω**

8. Test for less than 10 Ω between the control circuit terminal 2 and ground.

⇒ **If 10 Ω or greater**

8.1. Vehicle OFF, disconnect the harness connector at the S79P Window Switch-Passenger.

8.2. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the S79P Window Switch-Passenger.

⇓ **If less than 10 Ω**

9. Connect a test lamp between the control circuit terminal 1 and control circuit terminal 2, Vehicle in Service Mode.
10. Verify the test lamp turns ON when commanding the UP and DOWN functions with the S79P Window Switch-Passenger.

⇒ **If the test lamp remains OFF during either of the commands**

10.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S79P Window Switch-Passenger.

10.2. Test for infinite resistance between each control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

10.3. Test for less than 2 Ω in each control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the S79P Window Switch-Passenger.

⇒ **If the test lamp is always ON**

10.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S79P Window Switch-Passenger, Vehicle in Service Mode.

10.2. Test for less than 1 V between each control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, test or replace the S79P Window Switch-Passenger

⇓ **If the test lamp turns ON during each of the commands**

11. Test or replace the M74P Window Motor-Passenger.

Passenger Window Switch Inoperative

1. Vehicle OFF, disconnect the harness connector at the S79P Window Switch-Passenger, Vehicle in Service Mode
2. Verify a test lamp illuminates between the ignition circuit terminal 6 and ground.

⇒ **If the test lamp does not illuminate**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ignition circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.

⇓ **If the test lamp illuminates**

3. Test or replace the S79P Window Switch-Passenger.

Component Testing

Window Motor

1. Vehicle OFF, disconnect the harness connector at the appropriate M74 Window Motor.
2. Install a 25 A fused jumper wire between one of the control terminals and 12 V. Momentarily install a jumper wire between the other control terminal and ground. Reverse the jumper wires at least two times, the M74 Window Motor should perform the UP and DOWN functions.

⇒ **If the M74 Window Motor does not perform the UP and DOWN functions**

Replace the M74 Window Motor.

⇓ **If the M74 Window Motor performs the UP and DOWN functions**

3. All OK

Driver Window Switch

1. Vehicle OFF, disconnect the harness connector at the S79D Window Switch-Driver.
2. Test for infinite resistance between the terminals listed below with the switch in the open position:
   - Ignition terminal 6 and control terminal 1
   - Ignition terminal 6 and control terminal 2
   - Ignition terminal 6 and control terminal 4
   - Ignition terminal 6 and control terminal 5

⇒ **If less than infinite resistance**

Replace the S79D Window Switch-Driver.

⇓ **If infinite resistance**

3. Test for less than 3 Ω between the terminals listed below with the switch in the open position:
   - Ground terminal 3 and control terminal 1
   - Ground terminal 3 and control terminal 2
   - Ground terminal 3 and control terminal 4
   - Ground terminal 3 and control terminal 5

⇒ **If 3 Ω or greater**

Replace the S79D Window Switch-Driver.

⇓ **If less than 3 Ω**

4. Test for less than 3 Ω between the terminals listed below with the switch in the Up position.
   - Driver window left hand drive — ignition terminal 6 and control terminal 5
   - Driver window right hand drive — ignition terminal 6 and control terminal 1
   - Passenger window left hand drive — ignition terminal 6 and control terminal 4
   - Passenger window right hand drive — ignition terminal 6 and control terminal 2

⇒ **If 3 Ω or greater**

Replace the S79D Window Switch-Driver.

⇓ **If less than 3 Ω**

5. Test for less than 3 Ω between the terminals listed below with the switch in the Down position:
   - Driver window left hand drive — ignition terminal 6 and control terminal 2
   - Driver window right hand drive — ignition terminal 6 and control terminal 4
   - Passenger window left hand drive — ignition terminal 6 and control terminal 1
   - Passenger window right hand drive — ignition terminal 6 and control terminal 5

⇒ **If 3 Ω or greater**

Replace the S79D Window Switch-Driver.

⇓ **If less than 3 Ω**

6. All OK

Passenger Window Switch

1. Vehicle OFF, disconnect the harness connector at the S79P Window Switch-Passenger.
2. Test for infinite resistance between the terminals listed below with the switch in the open position:
   - Ignition terminal 6 and control terminal 1
   - Ignition terminal 6 and control terminal 3

⇒ **If less than infinite resistance**

Replace the S79P Window Switch-Passenger.

⇓ **If infinite resistance**

3. Test for less than 3 Ω between the control terminals listed below with the switch in the open position:
   - Control terminal 4 and control terminal 1
   - Control terminal 8 and control terminal 3

⇒ **If 3 Ω or greater**

Replace the S79P Window Switch-Passenger.

⇓ **If less than 3 Ω**

4. Test for less than 3 Ω between the ignition terminal 6 and the control terminal 1 with the switch in the Up position.

⇒ **If 3 Ω or greater**

Replace the S79P Window Switch-Passenger.

⇓ **If less than 3 Ω**

5. Test for less than 3 Ω between the ignition terminal 6 and the control terminal 3 with the switch in the Down position.

⇒ **If 3 Ω or greater**

Replace the S79P Window Switch-Passenger.

⇓ **If less than 3 Ω**

6. All OK

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Front Side Door Window Switch Replacement - Right Side on page 4-40*
- *Front Side Door Window Switch Replacement - Left Side on page 4-41*
- *Front Side Door Window Regulator Replacement on page 4-43*

Power Windows Malfunction (With AE3)

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Driver Window Switch Ignition, Terminal 2	7, 9	7, 9	—	—
Driver Window Switch Ignition, Terminal 8	2, 5	2, 4	—	—
Driver Window Switch Ground	—	1	—	—
Driver Window Motor Control	2, 5	2	2	—
Passenger Window Switch Ignition	2, 5	3	—	—
Passenger Window Switch Signal	2, 5	5	5	—
Passenger Window Motor Control	2, 5	5	5	—
Left Rear Window Switch Signal	7, 9	7	7	—
Left Rear Window Switch Lockout Control	7, 9	6	10	—
Left Rear Window Motor Control	7, 9	7	7	—
Right Rear Window Switch Signal	7, 9	9	9	—
Right Rear Window Switch Lockout Control	7, 9	8	10	—
Right Rear Window Motor Control	7, 9	9	9	—

1. All Power Windows Inoperative
2. Driver Window Inoperative
3. Passenger Window Inoperative from Passenger Switch
4. Passenger Window Inoperative from Driver Switch
5. Passenger Window Inoperative from Driver and Passenger Switches
6. Left Rear Window Inoperative from Left Rear Switch
7. Left Rear Window Inoperative from Driver and Left Rear Switches
8. Right Rear Window Inoperative from Right Rear Switch
9. Right Rear Window Inoperative from Driver and Right Rear Switches
10. Rear Window Lockout Inoperative

Circuit/System Description

The driver power window switch contains individual window switches for each of power windows. All windows may be controlled up and down from the driver power window switch. The individual passenger power window switches will only control the up and down operation of their respective power window.

Each power window contains a reversible power window motor. The direction the window travels is dependent upon the polarity of the supply voltage. By reversing polarity of the supply voltage the window motor will move up or down. Each power window motor is internally circuit breaker protected.

Battery voltage is supplied to the power window switch through the accessory voltage supply circuit. The power window switch also receives a constant ground source. The power window motor control circuits are connected to ground through the normally closed up and down contacts of the power window switch. When the power switch is placed in the down position, the power window motor down control circuit is switched to 12 V and is applied to the down side of the power window motor. Since the other side of the power motor is connected to ground through the normally closed contacts of the up switch, the window travels down. By placing the power window switch in the up position, the polarity of the power window motor is reversed and the window travels up.

Reference Information

Schematic Reference

Moveable Window Schematics on page 4-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Power Windows Description and Operation on page 4-51

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the driver window performs the UP and DOWN functions.

⇒ **If the driver window does not perform the UP or DOWN functions**

Refer to Circuit/System Testing – Driver Window Inoperative

⇓ **If the driver window performs the UP and DOWN functions**

3. Verify the passenger window performs the UP and DOWN functions at both the driver and passenger door switches.

⇒ **If the passenger window is inoperative from both the driver and passenger window switches**

Refer to Circuit/System Testing – Passenger Window Inoperative From Both Switches.

⇒ **If the passenger window is inoperative from the passenger window switch only**

Refer to Circuit/System Testing – Passenger Window Switch Inoperative.

⇒ **If the passenger window is inoperative from the driver window switch only**

Test or replace the S79D window switch – driver.

⇓ **If the passenger window performs the UP and DOWN functions at both switches**

4. Verify the left rear and right rear window performs the UP and DOWN functions at both the driver and each of the rear door switches.

⇒ **If a rear window is inoperative from both the driver and rear window switch**

Refer to Circuit/System Testing – Rear Window Inoperative From Both Switches

⇒ **If a rear window is inoperative from the rear window switch only**

Refer to Circuit/System Testing – Rear Window Lockout Malfunction

⇒ **If a rear window is inoperative from the driver window switch only**

Test or replace the S79D window switch – driver.

⇓ **If the rear window performs the UP and DOWN functions at both the driver and rear window switch**

5. Lock out the rear window switches by pressing the lockout switch on the driver window switch.
6. Verify the left rear and right rear windows are inoperative at both of the rear door switches .

⇒ **If both rear windows continue to function from the rear door switches**

Refer to Circuit/System Testing – Rear Window Lockout Malfunction

⇓ **If both rear windows are inoperative from the rear window switches**

7. All OK.

Circuit/System Testing

Driver Window Inoperative

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S79D Window Switch-Driver. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 13 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the ignition circuit terminal 8 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

4.1. Vehicle OFF.

4.2. Test for less than 2 Ω in the ignition circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, refer to *Retained Accessory Power Malfunction on page 11-863*.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

4.1. Vehicle OFF.

4.2. Test for infinite resistance between the ignition circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for infinite resistance between the control circuits listed below and ground:

- Control circuit terminal 7
- Control circuit terminal 9
- Control circuit terminal 12
- Control circuit terminal 14

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the S79D Window Switch-Driver.

⇓ **If the test lamp illuminates**

5. Vehicle OFF and all vehicle systems OFF, connect the harness connector at the S79D Window Switch-Driver and disconnect the harness connector at the M74D Window Motor-Driver. It may take up to 2 minutes for all vehicle systems to power down
6. Test for less than 10 Ω between the control circuit terminal 1 and ground.

⇒ **If 10 Ω or greater**

6.1. Vehicle OFF, disconnect the harness connector at the S79D Window Switch-Driver.

6.2. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the S79D Window Switch-Driver.

⇓ **If less than 10 Ω**

7. Test for less than 10 Ω between the control circuit terminal 2 and ground.

⇒ **If 10 Ω or greater**

7.1. Vehicle OFF, disconnect the harness connector at the S79D Window Switch-Driver.

7.2. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the S79D Window Switch-Driver.

⇓ **If less than 10 Ω**

8. Connect a test lamp between control circuit terminal 1 and control circuit terminal 2, Vehicle in Service Mode.
9. Verify the test lamp turns ON when commanding the UP and DOWN states with the S79D Window Switch-Driver.

⇒ **If the test lamp remains OFF during either of the commands**

9.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver.

9.2. Test for infinite resistance between each control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the S79D Window Switch-Driver.

⇒ **If the test lamp is always ON**

9.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver, Vehicle in Service Mode.

9.2. Test for less than 1 V between the control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the S79D Window Switch-Driver.

⇓ **If the test lamp turns ON and OFF**

10. Test or replace the M74D Window Motor-Driver.

Passenger Window Inoperative From Both Switches

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S79P Window Switch-Passenger. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the control circuit terminal 4 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF, disconnect the harness connector at the S79D Window Switch-Driver.

2.2. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the S79D Window Switch-Driver.

⇓ **If less than 10 Ω**

3. Test for less than 10 Ω between the control circuit terminal 8 and ground.

⇒ **If 10 Ω or greater**

3.1. Vehicle OFF, disconnect the harness connector at the S79D Window Switch-Driver.

3.2. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the S79D Window Switch-Driver.

⇓ **If less than 10 Ω**

4. Connect a test lamp between the control circuit terminal 4 and control circuit terminal 8, Vehicle in Service Mode.
5. Verify the test lamp turns ON when commanding the UP and DOWN functions with the S79D Window Switch-Driver.

⇒ **If the test lamp remains OFF during either of the commands**

5.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver.

5.2. Test for infinite resistance between each control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the S79D Window Switch-Driver.

⇒ **If the test lamp is always ON**

5.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver, Vehicle in Service Mode.

5.2. Test for less than 1 V between the control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the S79D Window Switch-Driver.

⇓ **If the test lamp turns ON and OFF**

6. Vehicle OFF and all vehicle systems OFF, connect the harness connector at the S79P Window Switch-Passenger and disconnect the harness connector at the M74P Window Motor-Passenger. It may take up to 2 minutes for all vehicle systems to power down.
7. Test for less than 10 Ω between the control circuit terminal 1 and ground.

⇒ **If 10 Ω or greater**

7.1. Vehicle OFF, disconnect the harness connector at the S79P Window Switch-Passenger.

7.2. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the S79P Window Switch-Passenger.

⇓ **If less than 10 Ω**

8. Test for less than 10 Ω between the control circuit terminal 2 and ground.

⇒ **If 10 Ω or greater**

8.1. Vehicle OFF, disconnect the harness connector at the S79P Window Switch-Passenger.

8.2. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the S79P Window Switch-Passenger.

⇓ **If less than 10 Ω**

9. Connect a test lamp between control circuit terminal 1 and control circuit terminal 2, Vehicle in Service Mode.
10. Verify the test lamp turns ON when commanding the UP and DOWN functions with the S79P Window Switch-Passenger.

⇒ **If the test lamp remains OFF during either of the commands**

10.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S79P Window Switch-Passenger.

10.2. Test for infinite resistance between each control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the S79P Window Switch-Passenger.

⇒ **If the test lamp is always ON**

10.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S79P Window Switch-Passenger, Vehicle in Service Mode.

10.2. Test for less than 1 V between the control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the S79P Window Switch-Passenger.

⇓ **If the test lamp turns ON and OFF**

11. Test or replace the M74P Window Motor-Passenger.

Passenger Window Switch Inoperative

1. Vehicle OFF, disconnect the harness connector at the S79P Window Switch-Passenger, Vehicle in Service Mode
2. Verify a test lamp illuminates between the ignition circuit terminal 6 and ground.

⇒ **If the test lamp does not illuminate**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ignition circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.

⇓ **If the test lamp illuminates**

3. Test or replace the S79P Window Switch-Passenger.

Rear Window Inoperative From Both Switches

1. Vehicle OFF, disconnect the harness connector at the S79D Window Switch-Driver. Vehicle in Service Mode
2. Verify a test lamp illuminates between the ignition circuit terminal 2 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ignition circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, refer to *Retained Accessory Power Malfunction on page 11-863*.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

2.1. Vehicle OFF.

2.2. Test for infinite resistance between the ignition circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

2.3. Test for infinite resistance between the control circuit terminals listed below and ground:

- Control circuit terminal 1
- Control circuit terminal 3
- Control circuit terminal 4
- Control circuit terminal 6
- Control circuit terminal 11

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the S79D Window Switch-Driver.

⇓ **If the test lamp illuminates**

3. Vehicle OFF, connect the harness connector at the S79D Window Switch-Driver and disconnect the harness connector at the appropriate rear S79 Window Switch.
4. Vehicle in Service Mode, verify that a test lamp illuminates between the control circuit terminal 6 and ground.

⇒ **If the test lamp does not illuminate**

4.1. Vehicle OFF.

4.2. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the S79D Window Switch-Driver

⇓ **If the test lamp illuminates**

5. Vehicle OFF and all vehicle systems OFF, it may take up to 2 minutes for all vehicle systems to power down
6. Test for less than 10 Ω between the control circuit terminal 4 and ground.

⇒ **If 10 Ω or greater**

6.1. Vehicle OFF, disconnect the harness connector at the S79D Window Switch-Driver.

6.2. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the S79D Window Switch-Driver.

⇓ **If less than 10 Ω**

7. Test for less than 10 Ω between the control circuit terminal 8 and ground.

⇒ **If 10 Ω or greater**

7.1. Vehicle OFF, disconnect the harness connector at the S79D Window Switch-Driver.

7.2. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the S79D Window Switch-Driver.

⇓ **If less than 10 Ω**

8. Connect a test lamp between the control circuit terminal 4 and control circuit terminal 8, Vehicle in Service Mode.
9. Verify the test lamp turns ON when commanding the UP and DOWN states with the S79D Window Switch-Driver.

⇒ **If the test lamp remains OFF during either of the commands**

9.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver.

9.2. Test for infinite resistance between each control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the S79D Window Switch-Driver.

⇒ **If the test lamp is always ON**

9.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver, Vehicle in Service Mode.

9.2. Test for less than 1 V between the control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the S79D Window Switch-Driver.

⇓ **If the test lamp turns ON and OFF**

10. Vehicle OFF and all vehicle systems OFF, connect the harness connector at the rear S79 Window Switch and disconnect the harness connector at the rear M74 Window Motor. It may take up to 2 minutes for all vehicle systems to power down.

11. Test for less than 10 Ω between the control circuit terminal listed below and ground:
    - Control terminal 1
    - Control terminal 2

⇒ **If 10 Ω or greater**

11.1. Vehicle OFF, disconnect the harness connector at the rear S79 Window Switch.

11.2. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the rear S79 Window Switch.

⇓ **If less than 10 Ω**

12. Connect a test lamp between the control circuit terminal 1 and the control circuit terminal 2, Vehicle in Service Mode.
13. Verify the test lamp turns ON when commanding the UP and DOWN states with the rear S79 Window Switch.

⇒ **If the test lamp remains OFF during either of the commands**

13.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the rear S79 Window Switch.

13.2. Test for infinite resistance between each control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the rear S79 Window Switch.

⇒ **If the test lamp is always ON**

13.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the rear S79 Window Switch, Vehicle in Service Mode.

13.2. Test for less than 1 V between the control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the rear S79 Window Switch.

⇓ **If the test lamp turns ON and OFF**

14. Test or replace the rear M74 Window Motor.

Rear Window Lockout Malfunction

1. Vehicle OFF, disconnect the harness connector at the appropriate rear S79 Window Switch.
2. Vehicle in Service Mode, connect a test lamp between the control circuit terminal 6 and ground.
3. Verify the test lamp turns ON and OFF when pressing the rear window lockout switch ON and OFF on the S79D Window Switch-Driver.

⇒ **If the test lamp is always OFF**

3.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver.

3.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

3.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the S79D Window Switch-Driver.

⇒ **If the test lamp is always ON**

3.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S79D Window Switch-Driver, Vehicle in Service Mode.

3.2. Test for less than 1 V between the control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the S79D Window Switch-Driver.

⇓ **If the test lamp turns ON and OFF**

4. Test or replace the rear S79 Window Switch.

Component Testing

Window Motor

1. Vehicle OFF, disconnect the harness connector at the appropriate M74 Window Motor.
2. Install a 25 A fused jumper wire between one of the control terminals and 12 V. Momentarily install a jumper wire between the other control terminal and ground. Reverse the jumper wires at least two times, the M74 Window Motor should perform the UP and DOWN functions.

⇒ **If the M74 Window Motor does not perform the UP and DOWN functions**

Replace the M74 Window Motor.

⇓ **If the M74 Window Motor performs the UP and DOWN functions**

3. All OK

Driver Window Switch

1. Vehicle OFF, disconnect the harness connector at the S79D Window Switch-Driver.
2. Test for infinite resistance between the terminals listed below with the switch in the open position:
    - Ignition terminal 8 and control terminal 7
    - Ignition terminal 8 and control terminal 9
    - Ignition terminal 8 and control terminal 12
    - Ignition terminal 8 and control terminal 14
    - Ignition terminal 2 and control terminal 1

- Ignition terminal 2 and control terminal 3
- Ignition terminal 2 and control terminal 4
- Ignition terminal 2 and control terminal 6

⇒ **If less than infinite resistance**

Replace the S79D Window Switch-Driver.

⇓ **If infinite resistance**

3. Test for less than 3 Ω between the terminals listed below with the switch in the open position:
   - Ground terminal 13 and control terminal 1
   - Ground terminal 13 and control terminal 3
   - Ground terminal 13 and control terminal 4
   - Ground terminal 13 and control terminal 6
   - Ground terminal 13 and control terminal 7
   - Ground terminal 13 and control terminal 9
   - Ground terminal 13 and control terminal 12
   - Ground terminal 13 and control terminal 14

⇒ **If 3 Ω or greater**

Replace the S79D Window Switch-Driver.

⇓ **If less than 3 Ω**

4. Test for less than 3 Ω between the terminals listed below with the switch in the Up position.
   - Driver window left hand drive — Ignition terminal 8 and control terminal 9
   - Driver window right hand drive — Ignition terminal 8 and control terminal 14
   - Passenger window left hand drive — Ignition terminal 8 and control terminal 14
   - Passenger window right hand drive — Ignition terminal 8 and control terminal 9
   - Left rear — Ignition terminal 2 and control terminal 3
   - Right rear — Ignition terminal 2 and control terminal 6

⇒ **If 3 Ω or greater**

Replace the S79D Window Switch-Driver.

⇓ **If less than 3 Ω**

5. Test for less than 3 Ω between the terminals listed below with the switch in the Down position:
   - Driver window left hand drive — Ignition terminal 8 and control terminal 7
   - Driver window right hand drive — Ignition terminal 8 and control terminal 12
   - Passenger window left hand drive — Ignition terminal 8 and control terminal 12
   - Passenger window right hand drive — Ignition terminal 8 and control terminal 7
   - Left rear — Ignition terminal 2 and control terminal 1
   - Right rear — Ignition terminal 2 and control terminal 4

⇒ **If 3 Ω or greater**

Replace the S79D Window Switch-Driver.

⇓ **If less than 3 Ω**

6. All OK

Passenger Window Switch

1. Vehicle OFF, disconnect the harness connector at the S79P Window Switch-Passenger.
2. Test for infinite resistance between the terminals listed below with the switch in the open position:
   - Ignition terminal 6 and control terminal 1
   - Ignition terminal 6 and control terminal 3

⇒ **If less than infinite resistance**

Replace the S79P Window Switch-Passenger.

⇓ **If infinite resistance**

3. Test for less than 3 Ω between the control terminals listed below with the switch in the open position:
   - Control terminal 4 and control terminal 1
   - Control terminal 8 and control terminal 3

⇒ **If 3 Ω or greater**

Replace the S79P Window Switch-Passenger.

⇓ **If less than 3 Ω**

4. Test for less than 3 Ω between the Ignition terminal 6 and the control terminal 1 with the switch in the Up position.

⇒ **If 3 Ω or greater**

Replace the S79P Window Switch-Passenger.

⇓ **If less than 3 Ω**

5. Test for less than 3 Ω between the Ignition terminal 6 and the control terminal 3 with the switch in the Down position.

⇒ **If 3 Ω or greater**

Replace the S79P Window Switch-Passenger.

⇓ **If less than 3 Ω**

6. All OK

Rear Window Switch

1. Vehicle OFF, disconnect the harness connector at the appropriate rear S79 Window Switch.
2. Test for infinite resistance between the terminals listed below with the switch in the open position:
   - Control terminal 6 and control terminal 1
   - Control terminal 6 and control terminal 3

⇒ **If less than infinite resistance**

Replace the rear S79 Window Switch.

⇓ **If infinite resistance**

3. Test for less than 3 Ω between the control terminals listed below with the switch in the open position:
   - Control terminal 4 and control terminal 1
   - Control terminal 8 and control terminal 3

⇒ **If 3 Ω or greater**

Replace the rear S79 Window Switch.

⇓ **If less than 3 Ω**

4. Test for less than 3 Ω between the control terminal 6 and the control terminal 1 with the switch in the Up position.

⇒ **If 3 Ω or greater**

Replace the rear S79 Window Switch.

⇓ **If less than 3 Ω**

5. Test for less than 3 Ω between the control terminal 6 and the control terminal 3 with the switch in the Down position.

⇒ **If 3 Ω or greater**

Replace the rear S79 Window Switch.

⇓ **If less than 3 Ω**

6. All OK

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Front Side Door Window Switch Replacement - Right Side on page 4-40*
- *Front Side Door Window Switch Replacement - Left Side on page 4-41*
- *Front Side Door Window Regulator Replacement on page 4-43*
- *Rear Side Door Window Regulator Replacement on page 4-44*

Side Door Window Mechanical Diagnosis

Cause	Correction
DEFINITION: A mechanical condition that requires a correction for proper operation of the side door window. Refer to *Symptoms - Fixed and Moveable Windows on page 4-10* prior to beginning this table.	
Intermittent Operation	Check proper glass alignment/attachment and door seal installation.
	Check switch and switch bezel to see if sticking.
	Check wire harness for pinched/shorted wire.
	THIS STEP APPLIES TO ALL TWO PIN MOTOR CONNECTORS ONLY. Perform electrical diagnostics, by first applying 12 volt power supply to the regulator motor to verify motor function.
Glass Binds	Check proper glass alignment/attachment.
	Check for defective seal and/or proper seal installation.
	Check for debris in glass run channel.
	Check for glass run channel position.
Regulator/Glass Rattles	Check for loose fasteners and retorque if required.
	Check that the glass is in the channel and reinstall if not positioned correctly.
Noisy Operation	Check for other components in the glass path such as wire harness, impact foam, lock rods, or cables.
	Check for proper glass alignment/attachment and door seal installation.
Windnoise	Check seals, mirror patch, and glass alignment.
False glass reversal, the glass goes down unexpectedly.	Check seals, reinitialize the glass and/or realign the glass.
	Check for debris in the glass run channel.

Repair Instructions

Windshield Replacement

Special Tools

- *BO-39032* Stationary Glass Removal Tool
- Use a urethane adhesive systems which meet GM Specification GMW 15672

For equivalent regional tools, refer to *Special Tools on page 4-54*.

Removal Procedure

1. Open the hood.
2. Remove the windshield wiper arms. Refer to *Windshield Wiper Arm Replacement on page 4-328*.
3. Remove the air inlet grille. Refer to *Air Inlet Grille Panel Replacement on page 4-327*.
4. Remove the sunshade. Refer to *Sunshade Replacement on page 2-60*.
5. Lower the front section of the headlinder only to access the urethane adhesive bead. Refer to *Headlining Trim Panel Replacement on page 2-20*.

   Note: If the windshield is equipped with a blackout area around the mirror base bracket Care Must be used not to cut or scrape the blackout. If the mount bracket come off the windshield it can Not be reinstalled and the windshield must be replaced. If the bracket is bonded to the windshield it is Not reusable. Remove all sensor, cover, electrical devices, and bracket. from the pins. If the bracket is bonded to the windshield it is Not reusable.
6. Remove the inside rearview mirror. Refer to *Inside Rearview Mirror Replacement on page 4-215*.
7. Remove the windshield garnish moldings left and right side. Refer to *Windshield Garnish Molding Replacement on page 2-61*.

Warning: If broken glass falls into the defroster outlets, it can be blown into the passenger compartment and cause personal injury.

8. Cover to protect the following parts from broken glass:
   - Upper dash pad
   - Defroster outlets and A/C outlets
   - Seats and carpeting
9. Using the appropriate tool, carefully cut the lace from around the window in order to access the urethane adhesive bead.

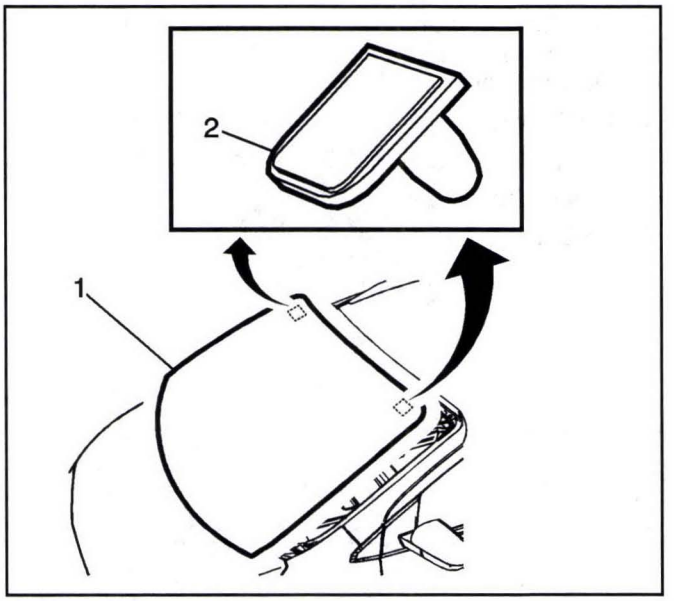
Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5.

Note: If reusing the window use care not to cut off the locator pins located in the upper corners. If the locating pins are cut off in the removal it will be necessary to use masking tape to tape the window in place until the urethane adhesive cures.

10. Do the following steps when separated the window from the urethane adhesive:
    - Leave a base of urethane adhesive on the pinchweld flange.
    - The only suitable lubrication is clean water, no oils, lubes or soaps.
    - *BO-39032* Stationary Glass Removal Tool, or equivalent in order to remove the window.

379883

11. Using the appropriate tool, cut along the bottom of the window separating the window from urethane adhesive. Keep the cutting edge of the tool against the window. Do this from inside the vehicle. While cutting from inside the vehicle, reposition the tool to cut the urethane adhesive along the top and both sides to release the window completely.
12. Remove the windshield upper reveal molding from the window. Refer to *Windshield Upper Reveal Molding Replacement on page 4-30*.



2732758

13. Remove the window (1) from the vehicle with an assistant and Do the following:
    13.1. After removing the window spacers and mark the location of each one. If equipped.
    13.2. Check that the locator pins are still attached to each upper corner of the window for installing, if reusing.
    13.3. Remove all mounds or loose pieces of urethane adhesive from the pinchweld area.
    13.4. If the original window is being reused, remove all but approximately 2 mm (0.078 in) of the existing bead of urethane adhesive from the pinchweld flange surface, using a clean utility knife or razor blade scraper.
14. Inspect for any of the following conditions in order to help prevent future breakage of the window:
    - High weld
    - Solder spots
    - Hardened sealer
    - Any other obstruction or irregularity in the pinchweld flange

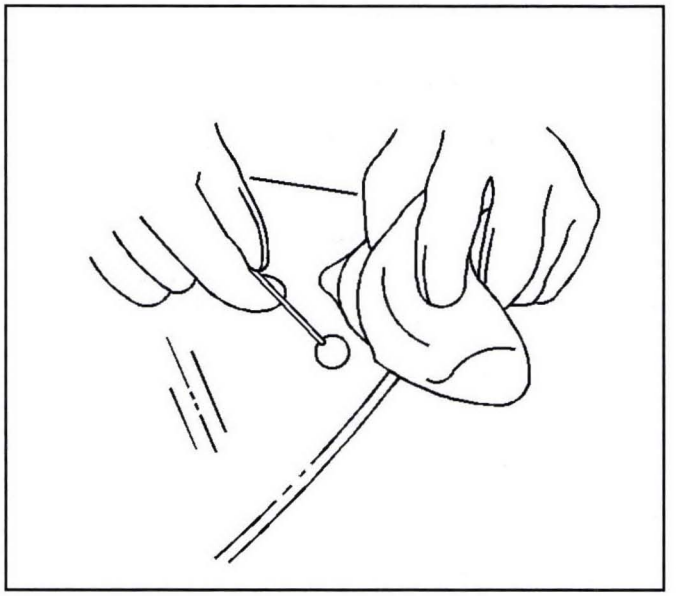
    Note: If corrosion of the pinchweld flange is present or if sheet metal repairs or replacements are required, the pinchweld flange must be refinished in order to restore the bonding area strength. If paint repairs are required, mask the flange bonding area prior to applying the color coat in order to provide a clean primer only surface. Materials such as BASF DE15®, DuPont 2610®, Sherwin-Williams PSE 4600 and NP70® and Martin-Semour 5120 and 5130® PPG DP90LF SPIES/HECKER 3688/8590 – 3688/5150 – 4070/5090 STANDOX 11158/13320 — 14653/14980 products are approved for this application.

15. After repairing the opening as indicated, perform the following steps:
    15.1. Remove all traces of broken glass from the outer cowl panel, seats, floor and defroster ducts.
    15.2. Clean around the edge of the inside surface of the window with a 50/50 mixture of isopropyl alcohol and water by volume on a dampened lint free cloth.

Installation Procedure

Warning: Failure to prep the area prior to the application of primer may cause insufficient bonding of urethane adhesive. Insufficient bonding of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.

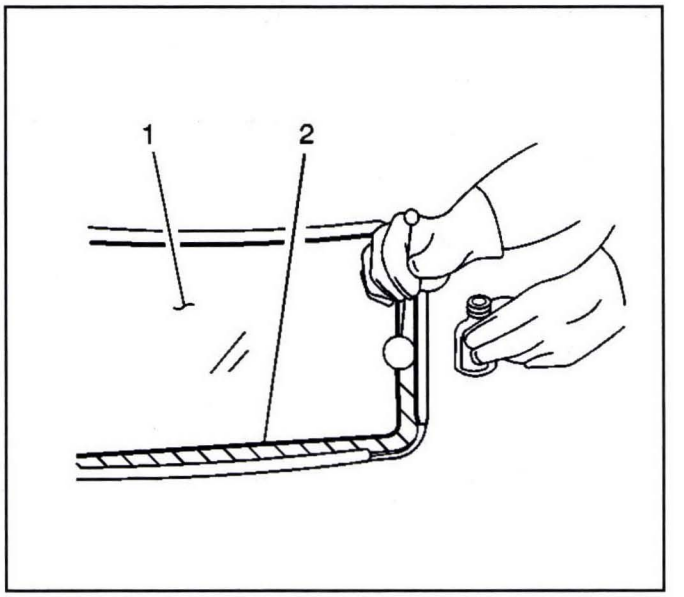
1. Verify that all primers and urethane adhesive being used are within expiration dates.
2. If reusing or replacing the window, use the appropriate tool, remove the urethane adhesive bead on the window surface and pinchweld flange to approximately 2 mm (0.078 in).



379890

Note: Use Prep #1 Clear

3. Apply the Prep #1 clear primer to the bonding surface of the windows inside edge and the bonding surface of the pinchweld flange opening, refer to the instructions of the manufacturer's.



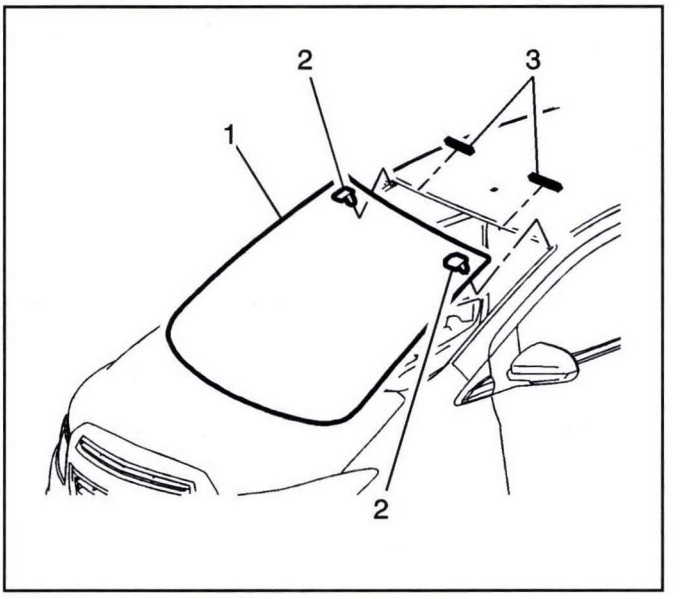
245290

Note: Do not apply the black primer to the existing bead of the urethane adhesive on the pinch-weld flange. Apply the primer only to nicks, scratches or the primed surfaces.

Note: Following the urethane adhesive installation instructions, using P/N 9981062 (VM/P Naphtha) or equivalent to remove any excess of urethane adhesive within 3 minutes, otherwise it may not be possible to remove the urethane adhesive excess unless using mechanical means.

Note: The Prep #2 Black Primer is for, Blackout primer, UV Blackout.

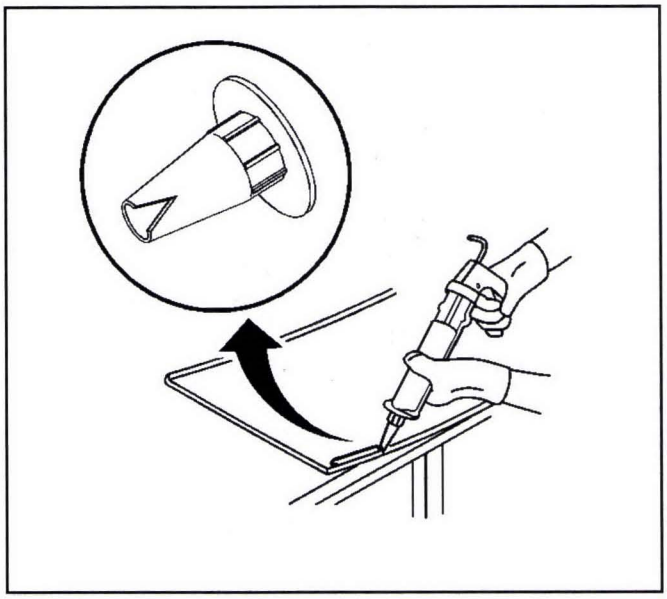
4. Apply the Prep #2 urethane adhesive primer (2) around the perimeter of the window (1), refer to the instructions of the manufacturer's.



2842302

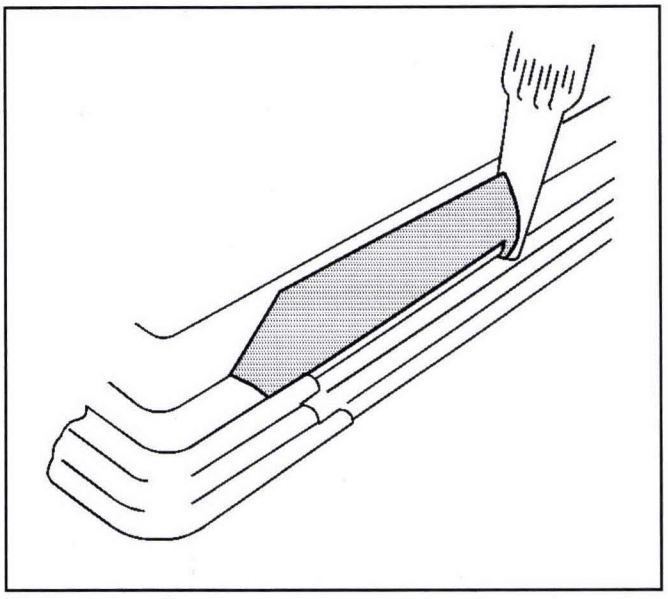
5. Install the spacers (2) for the window (1) to the marked locations on the pinchweld flange. If equipped

6. Install the windshield upper reveal molding to the window. Refer to *Windshield Upper Reveal Molding Replacement on page 4-30*.



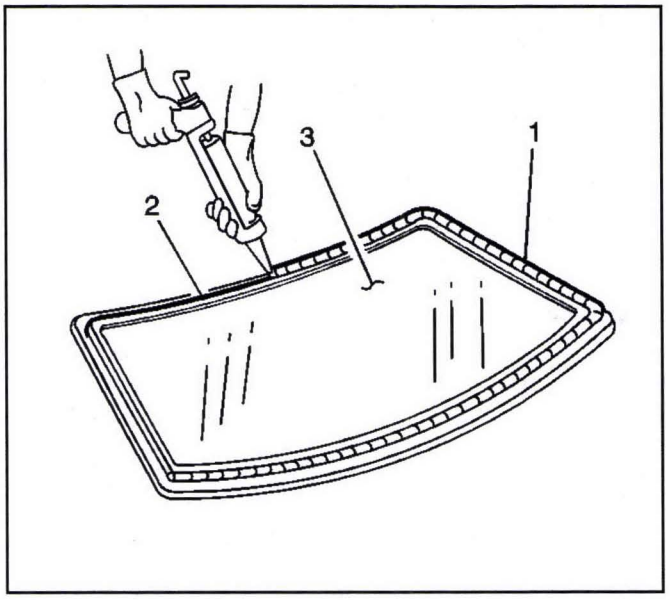
161427

7. Cut the applicator nozzle in order to provide a bead of 12.7 mm (1/2 in) wide and 12.7 mm (1/2 in) high.



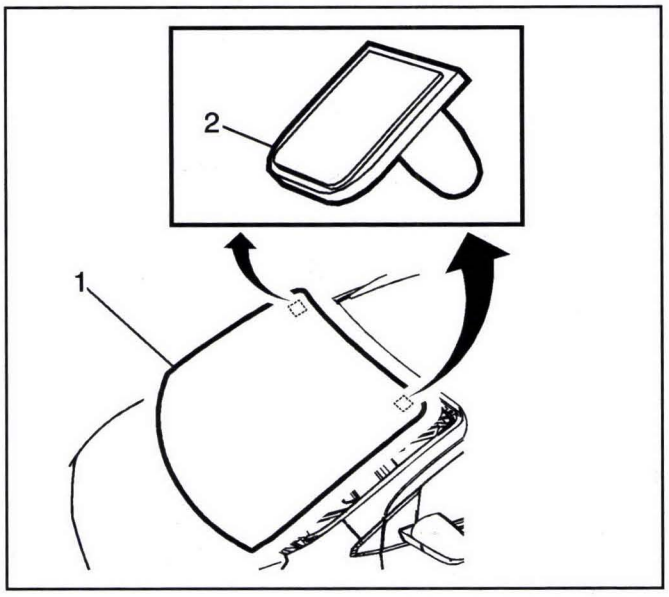
161429

8. Use the appropriate tool in order to apply a smooth, continuous bead of urethane adhesive to the window or the pinchweld flange.



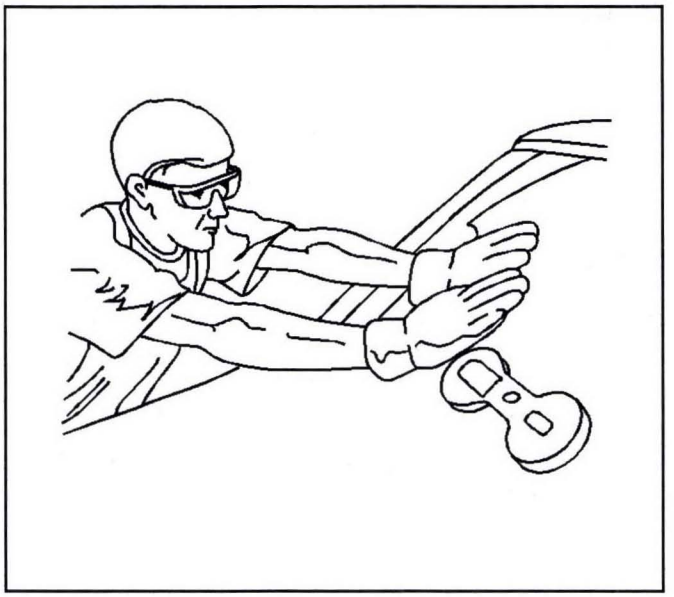
245315

9. Use the edge of the window as a guide for the nozzle in order to apply a continuous bead of urethane adhesive (1) to the inner surface of the window (3).



2732758

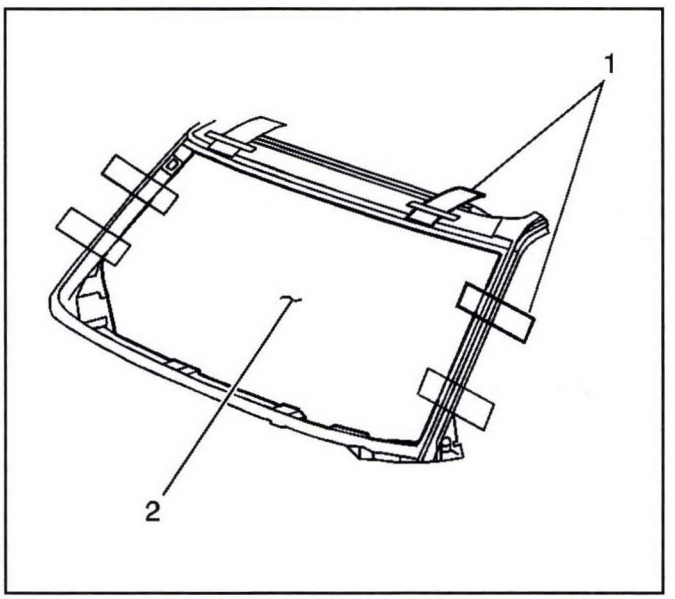
10. With an assistant, place the window (1) and locators (2) into the locator slots in the pinchweld flange of the vehicle.



706204

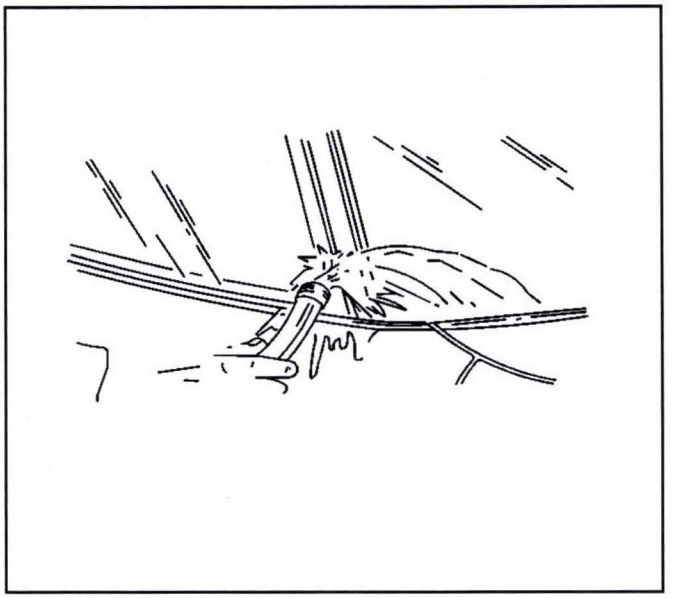
Note: To prevent damage to the window due to objects impacting an exposed edge, upon installation, the window must rest 1 mm (0.040 in) below the surface of the roof sheet metal.

11. Press firmly around the entire periphery of the window in order to wet-out the urethane adhesive bead.



745571

12. Use masking tape (1) to hold the window (2) in the position until the urethane adhesive completely cures.
13. Remove the double layer of masking tape around the perimeter of the painted surfaces and the interior trim.



95572

Note: Do not direct a hard stream of high pressure water to the freshly applied urethane adhesive.

14. Use a soft spray of warm water in order to immediately water test the window.
15. Inspect the window for leaks.
16. If any leaks are found, use a plastic paddle in order to apply extra urethane adhesive at the leak point.
17. Retest the window for leaks.

Warning: Insufficient curing of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.

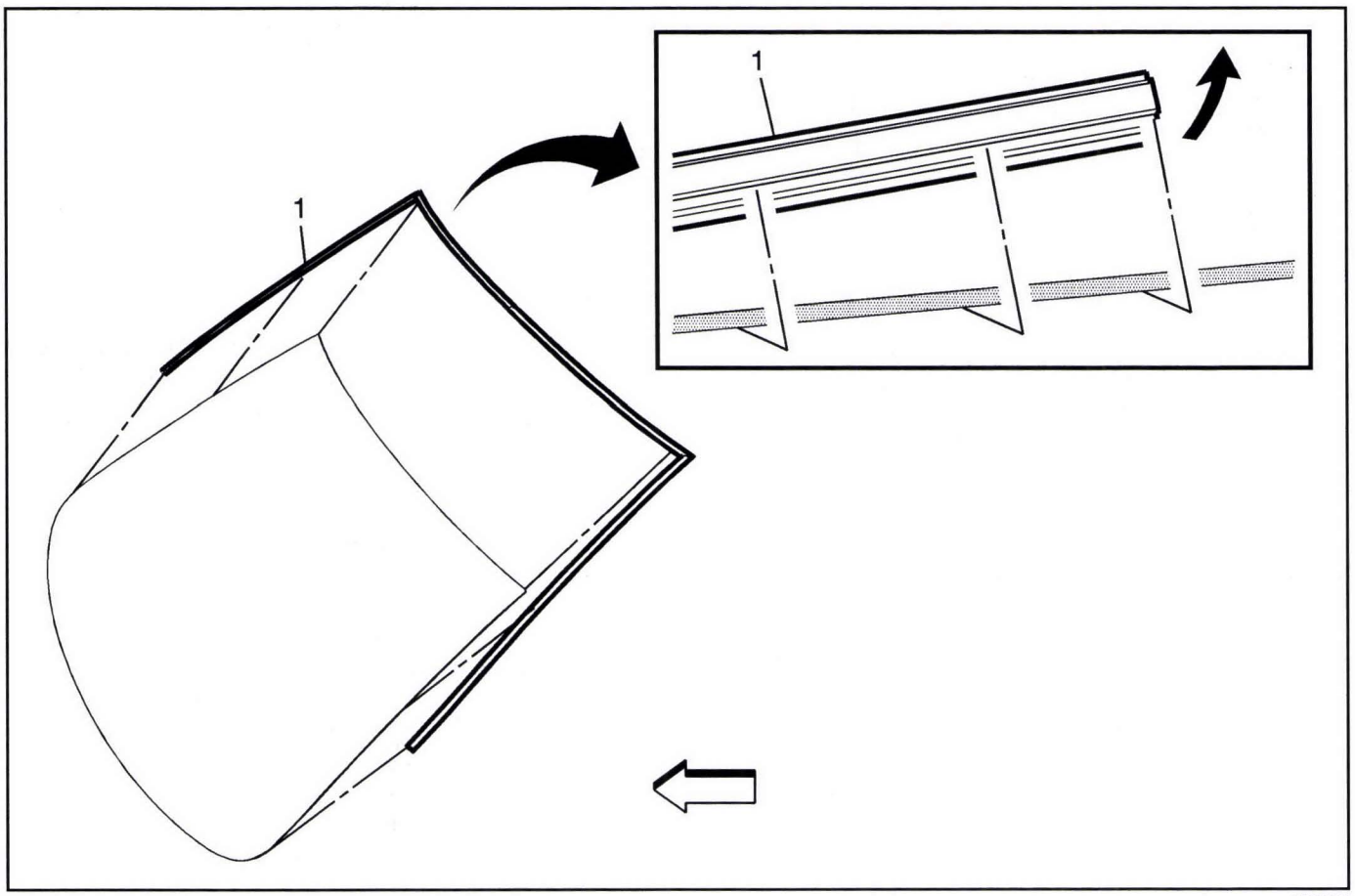
- ***For the moisture-curing type of urethane adhesive, allow a minimum of 6 hours at 21°C (70°F) or greater and with at least 30 percent relative humidity. Allow at least 24 hours for the complete curing of the urethane adhesive.***
- ***For the chemical-curing type of urethane adhesive, allow a minimum of 1 hour .***

Do NOT physically disturb the repair area until after these minimum times have elapsed.

18. Maintain the following conditions in order to properly cure the urethane adhesive by manufacturers instructions:
    - Partially lower a door window in order to prevent pressure buildups when closing doors before the urethane adhesive cures.
    - Do not drive the vehicle until the urethane adhesive is cured. Refer to the instructions of the manufacturers curing times.
    - Do not use compressed air in order to dry the urethane adhesive.
19. Install the front section of the headlinder only. Refer to *Headlining Trim Panel Replacement on page 2-20*.
20. Install the sunshade. Refer to *Sunshade Replacement on page 2-60*.
21. Install the rearview mirror. Refer to *Inside Rearview Mirror Replacement on page 4-215*.

22. Install the windshield garnish moldings left and right side. Refer to *Windshield Garnish Molding Replacement on page 2-61*.
23. Install the air inlet grille. Refer to *Air Inlet Grille Panel Replacement on page 4-327*.
24. Install the windshield wipers arms. Refer to *Windshield Wiper Arm Replacement on page 4-328*.
25. Remove the double layer of masking tape around the perimeter of the painted surfaces and the interior trim.
26. Close the hood.

Windshield Upper Reveal Molding Replacement

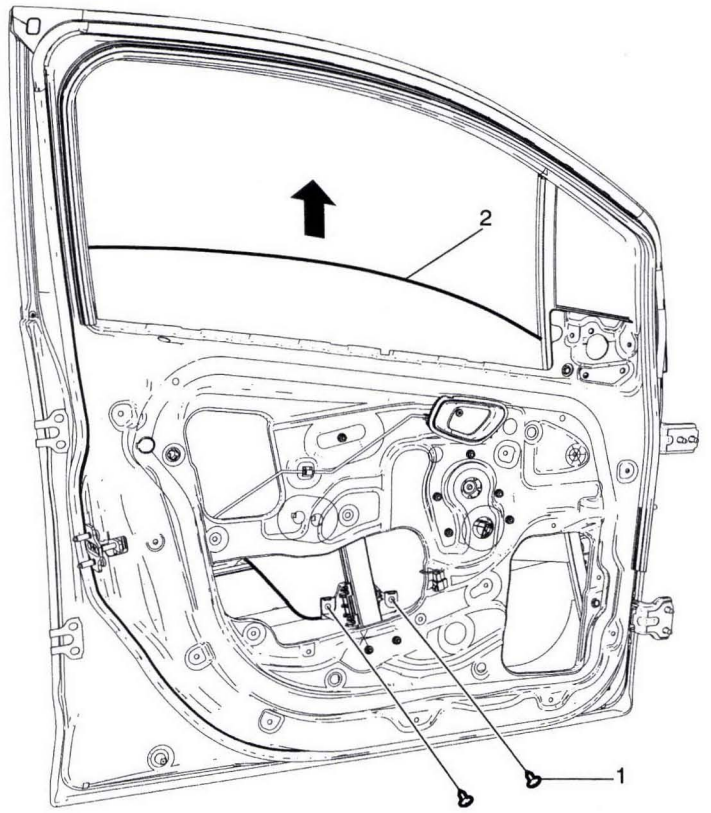


2425010

Windshield Upper Reveal Molding Replacement

Callout	Component Name
Preliminary Procedures Remove the windshield to replace the reveal molding. Refer to *Windshield Replacement on page 4-25*.	
1	Windshield Reveal Molding ***Warning: Refer to Glass and Sheet Metal Handling Warning on page 0-5.*** **Procedure** 1. Mark the window at both ends before remove the reveal molding for installing. 2. Place the window on a clean and dry surface. 3. Use a suitable plastic tool, use care when releasing the reveal molding not to pry on the window. 4. Clean around the edges and surface of the window and molding with a 50/50 mixture of isopropyl alcohol and water by volume on a dampened lint free cloth.

Front Side Door Window Replacement

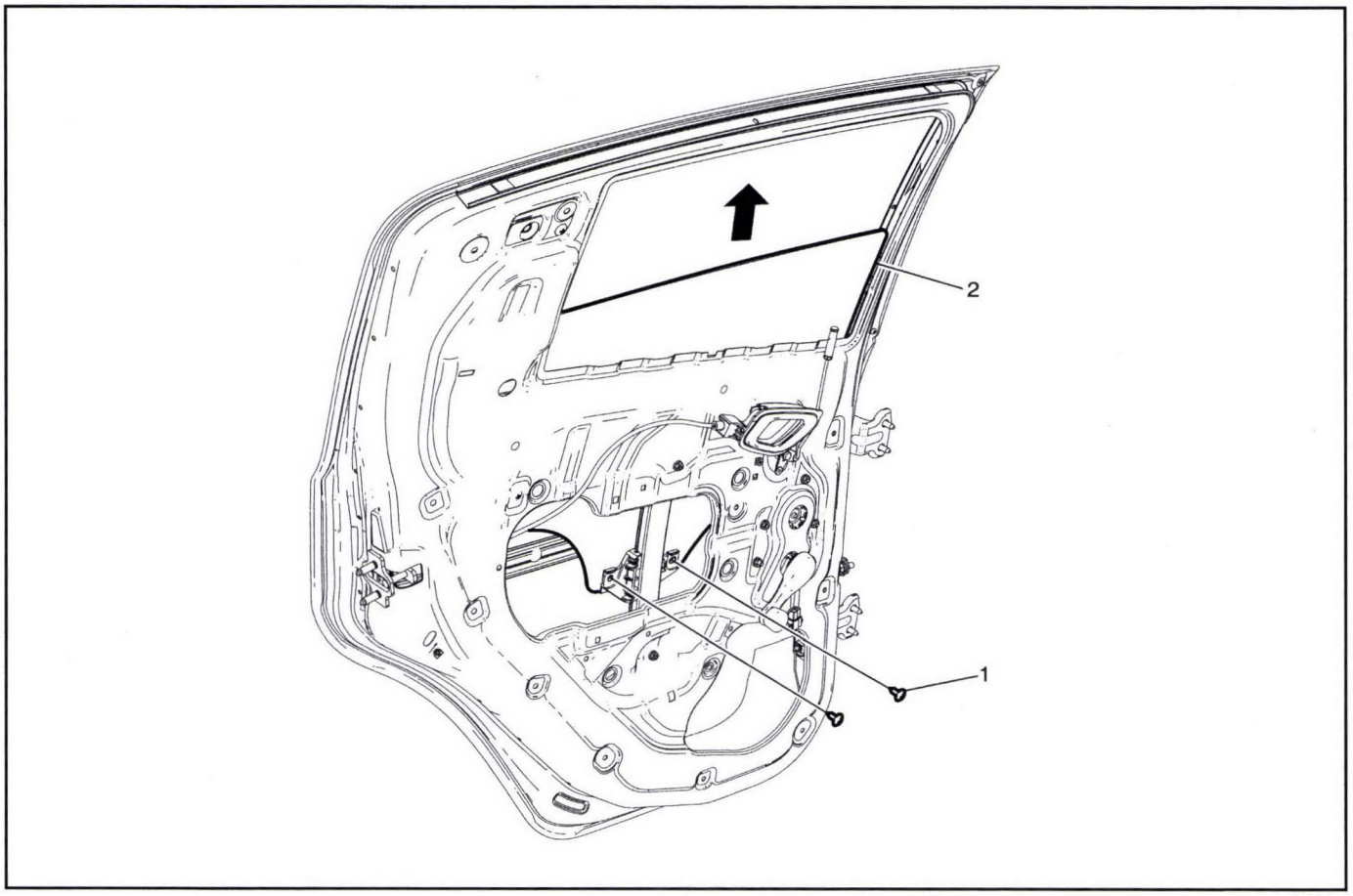


2309134

Front Side Door Window Replacement

Callout	Component Name
Preliminary Procedure 1. Position the window approximately half way down in the door. 2. Remove the front side door trim panel. Refer to *Front Side Door Trim Replacement on page 2-53*. 3. Remove the water deflector.	
1	Front Side Door Window Regulator Sash Screw (Qty 2) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 2 N•m (18 lb in)
2	Front Side Door Window **Procedure** 1. Remove the window regulator sash screws, and then move the window to full down position using the window switch and regulator. 2. Rotate the front door window as necessary to remove it from the door.

Rear Side Door Window Replacement



2309137

Rear Side Door Window Replacement

Callout	Component Name
Preliminary Procedure 1. Position the window approximately half way down in the door. 2. Remove the rear side door trim. Refer to *Rear Side Door Trim Replacement on page 2-68*. 3. Remove the rear side door window regulator. Refer to *Rear Side Door Window Regulator Replacement on page 4-44*. 4. Remove the outer sealing strip. Refer to *Front Side Door Window Outer Sealing Strip Replacement on page 4-45*.	
1	Rear Side Door Window Regulator Sash Screw (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 2 N•m (18 lb in)
2	Rear Side Door Window **Procedure** 1. After removing the window regulator, detach the window from the window frame and lower the window into the door panel. 2. Partially remove the rear window weatherstrip to remove the rear window channel. Refer to *Rear Side Door Window Weatherstrip Replacement on page 4-50*. 3. Loosen the window regulator sash nuts, pull upward to release the window from the sash. 4. Rotate the rear door window as necessary to remove it from the door.

Liftgate Window Replacement

Special Tools

- *BO-39032* Stationary Glass Removal Tool or equivalent
- Use a urethane adhesive systems which meet GM Specification GMW 15672.

For equivalent regional tools, refer to *Special Tools on page 4-54*

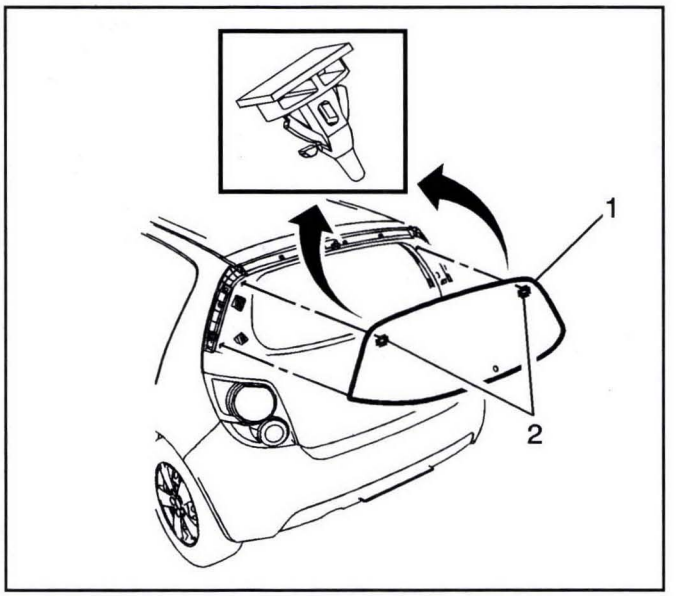
Removal Procedure

Warning: Refer to Cracked Window Warning on page 0-4.

Note: Before cutting out a stationary window, apply a double layer of masking tape around the perimeter of the painted surfaces and the interior trim.

1. Open the liftgate.
2. Remove the liftgate trim. Refer to *Liftgate Trim Finish Panel Replacement on page 2-70*.
3. Disconnect the electrical connectors from the liftgate window defogger bus bar.
4. Remove the rear window wiper arm. Refer to *Rear Window Wiper Arm Replacement on page 4-329*.
5. Remove the rear spoiler. Refer to *Rear End Spoiler Replacement on page 2-17*.
6. Cover the following parts to protect from broken glass, seats and carpeting.

   Note: Keep the cutting edge of the appropriate tool against the window. There are window locating pins, one in each upper corner of the window. Use care Not to remove or cut them off when removing the window. If the window locator pins are cut, it will be necessary to tape the window in place.
7. This will allow the auto-adhesive to be separated from the window.
   - Leave a base of urethane adhesive on the pinchweld flange.
   - The only suitable lubrication is clean water, no oils, lubes or soaps.
   - *BO-39032* Stationary Glass Removal Tool, or equivalent in order to remove the window.



2424999

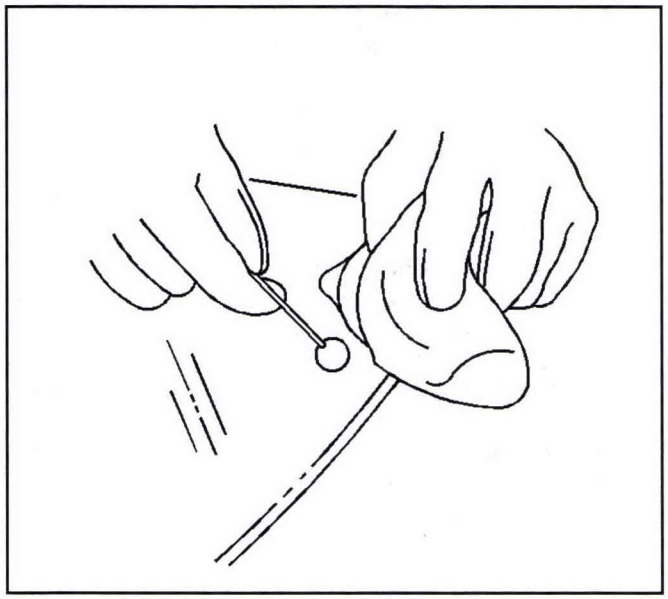
8. Remove the window (1) from the vehicle with an assistant and Do the following:
   8.1. After removing the window spacers and mark the location of each one. If equipped.
   8.2. Check that the locator pins (2) are still attached to each upper corner of the window for installing, if reusing.
   8.3. Remove all mounds or loose pieces of urethane adhesive from the pinchweld area.
   8.4. If the original window is being reused, remove all but approximately 2 mm (0.078 in) of the existing bead of urethane adhesive from the pinchweld flange surface, using a clean utility knife or razor blade scraper.
9. Inspect for any of the following conditions in order to help prevent future breakage of the window:
   - High weld
   - Solder spots
   - Hardened sealer
   - Any other obstruction or irregularity in the pinchweld flange

   Note: If corrosion of the pinchweld flange is present or if sheet metal repairs or replacements are required, the pinchweld flange must be refinished in order to restore the bonding area strength. If paint repairs are required, mask the flange bonding area prior to applying the color coat in order to provide a clean primer only surface. Materials such as BASF DE15®, DuPont 2610®, Sherwin-Williams PSE 4600 and NP70® and Martin-Semour 5120 and 5130® PPG DP90LF SPIES/HECKER 3688/8590 – 3688/5150 – 4070/5090 STANDOX 11158/13320 — 14653/14980 products are approved for this application.
10. After repairing the opening as indicated, perform the following steps:
    10.1. Remove all traces of broken glass from the outer cowl panel, seats, floor and defroster ducts.
    10.2. Clean around the edge of the inside surface of the window with a 50/50 mixture of isopropyl alcohol and water by volume on a dampened lint free cloth.

Installation Procedure

Warning: Failure to prep the area prior to the application of primer may cause insufficient bonding of urethane adhesive. Insufficient bonding of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.

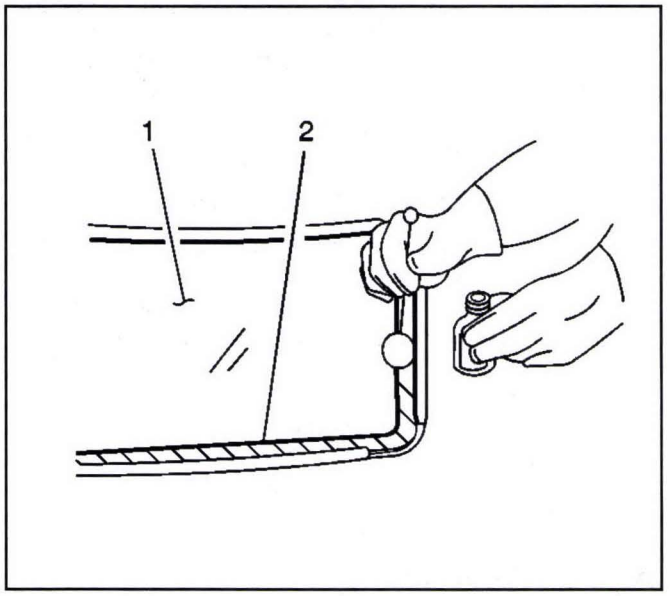
1. Verify that all primers and urethane adhesive being used are within expiration dates.
2. If reusing or replacing the window, use the appropriate tool, remove the urethane adhesive bead on the window surface and pinchweld flange to approximately 2 mm (0.078 in).



379890

Note: Use Prep #1 Clear

3. Apply the Prep #1 clear primer to the bonding surface of the windows inside edge and the bonding surface of the pinchweld flange opening, refer to the instructions of the manufacturer's.



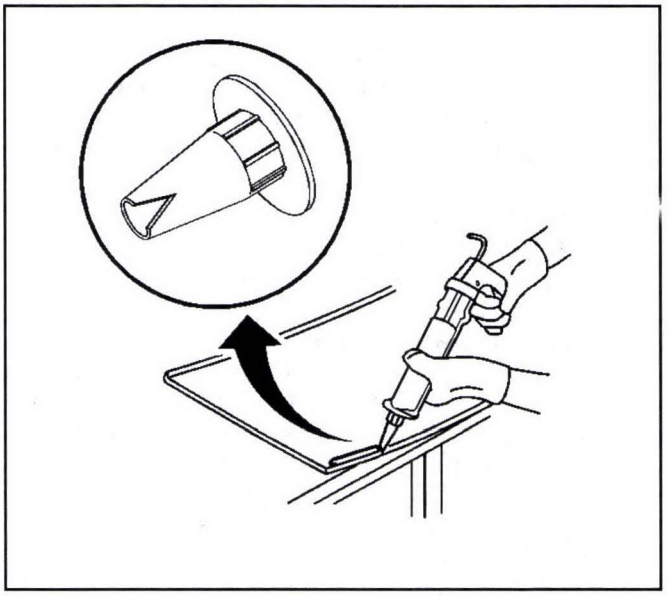
245290

Note: Do not apply the black primer to the existing bead of the urethane adhesive on the pinch-weld flange. Apply the primer only to nicks, scratches or the primed surfaces.

Note: Following the urethane adhesive installation instructions, using P/N 9981062 (VM/P Naphtha) or equivalent to remove any excess of urethane adhesive within 3 minutes, otherwise it may not be possible to remove the urethane adhesive excess unless using mechanical means.

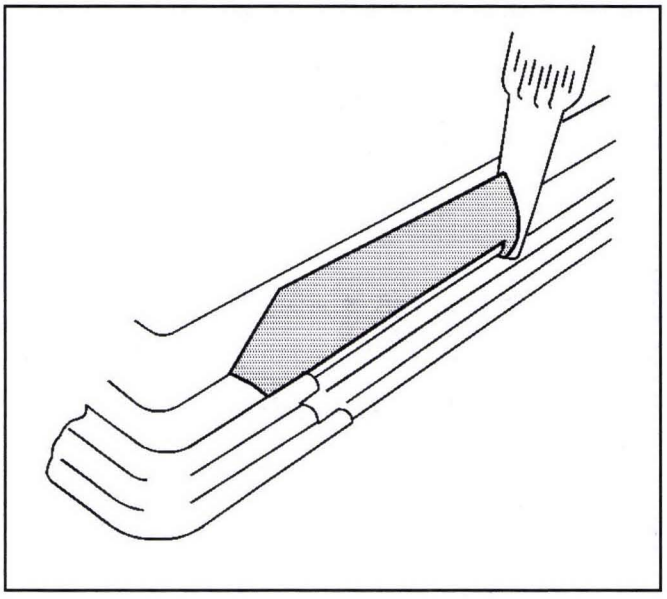
Note: The Prep #2 Black Primer is for, Blackout primer, UV Blackout.

4. Apply the Prep #2 urethane adhesive primer (2) around the perimeter of the window (1), refer to the instructions of the manufacturer's.
5. Install the spacers for the window to the marked locations on the pinchweld flange. If equipped
6. Install the liftgate upper reveal molding to the window. Refer to *Windshield Upper Reveal Molding Replacement on page 4-30*.



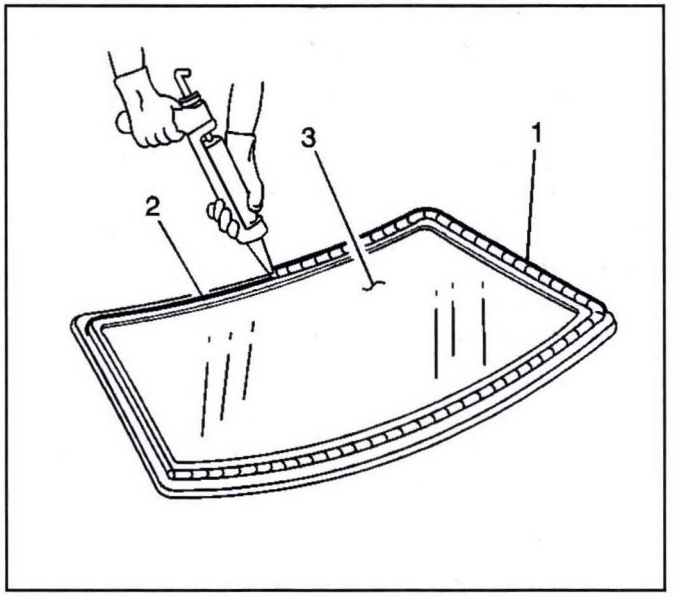
161427

7. Cut the applicator nozzle in order to provide a bead of 12.7 mm (1/2 in) wide and 12.7 mm (1/2 in) high.



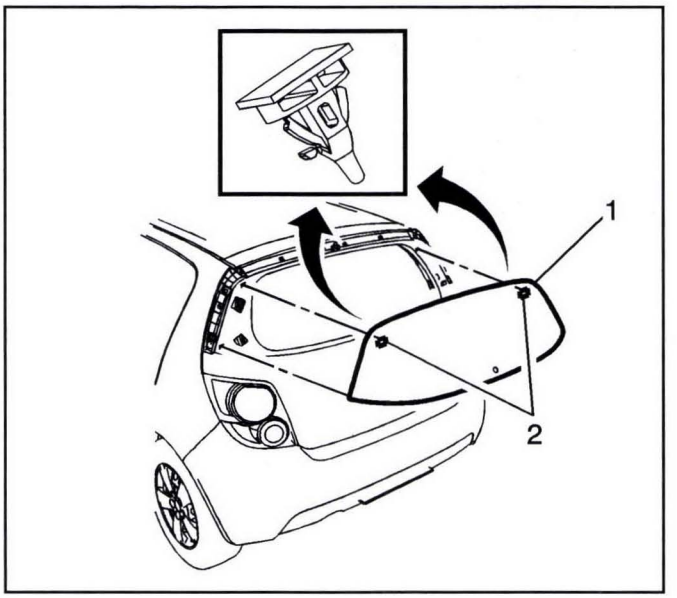
161429

8. Use the appropriate tool in order to apply a smooth, continuous bead of urethane adhesive to the window or the pinchweld flange.



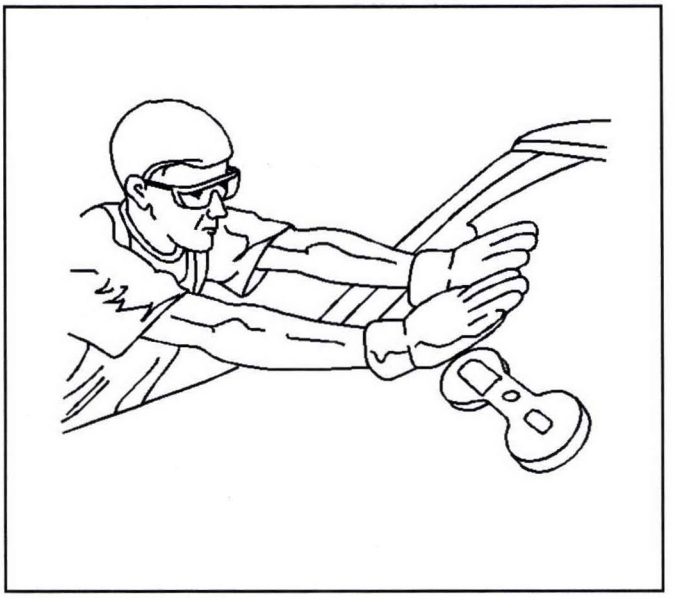
245315

9. Use the edge of the window as a guide for the nozzle in order to apply a continuous bead of urethane adhesive (1) to the inner surface of the window (3).



2424999

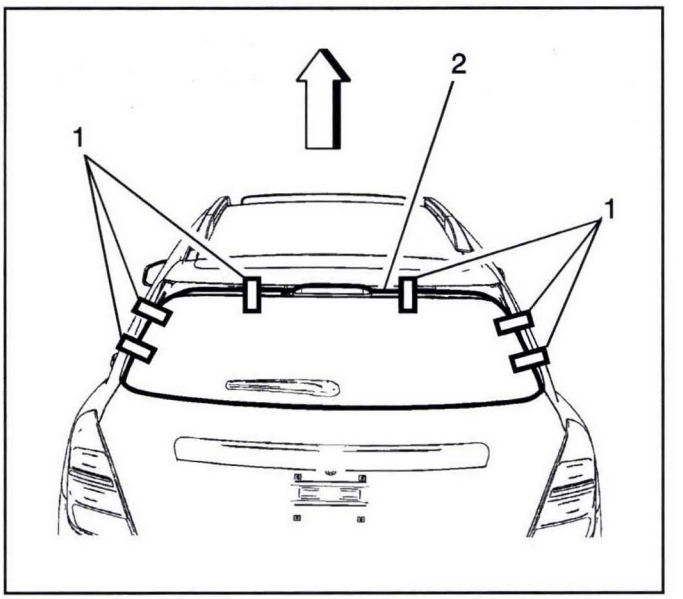
10. With an assistant, place the window (1) and locators (2) into the locator slots in the pinchweld flange of the vehicle.



706204

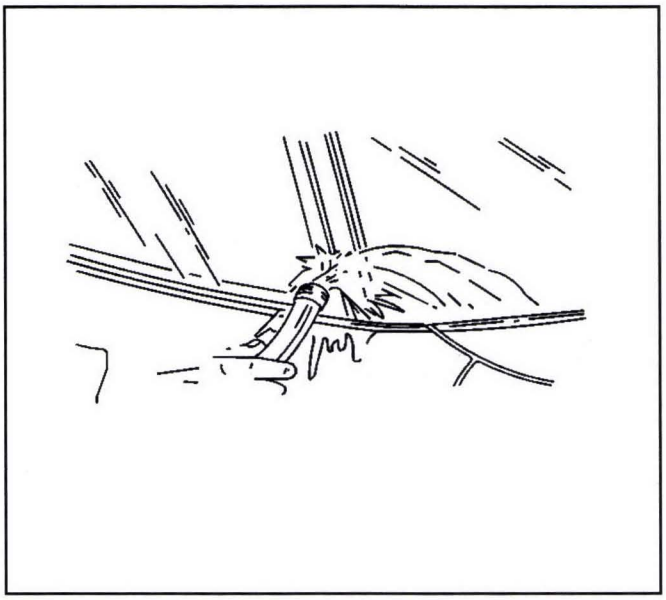
Note: To prevent damage to the window due to objects impacting an exposed edge, upon installation, the window must rest 1 mm (0.040 in) below the surface of the roof sheet metal.

11. Press firmly around the entire periphery of the window in order to wet-out the urethane adhesive bead.



2858915

12. Use masking tape (1) to hold the window (2) in the position until the urethane adhesive completely cures.
13. Remove the double layer of masking tape around the perimeter of the painted surfaces and the interior trim.



95572

Note: Do not direct a hard stream of high pressure water to the freshly applied urethane adhesive.

14. Use a soft spray of warm water in order to immediately water test the window.
15. Inspect the window for leaks.
16. If any leaks are found, use a plastic paddle in order to apply extra urethane adhesive at the leak point.
17. Retest the window for leaks.

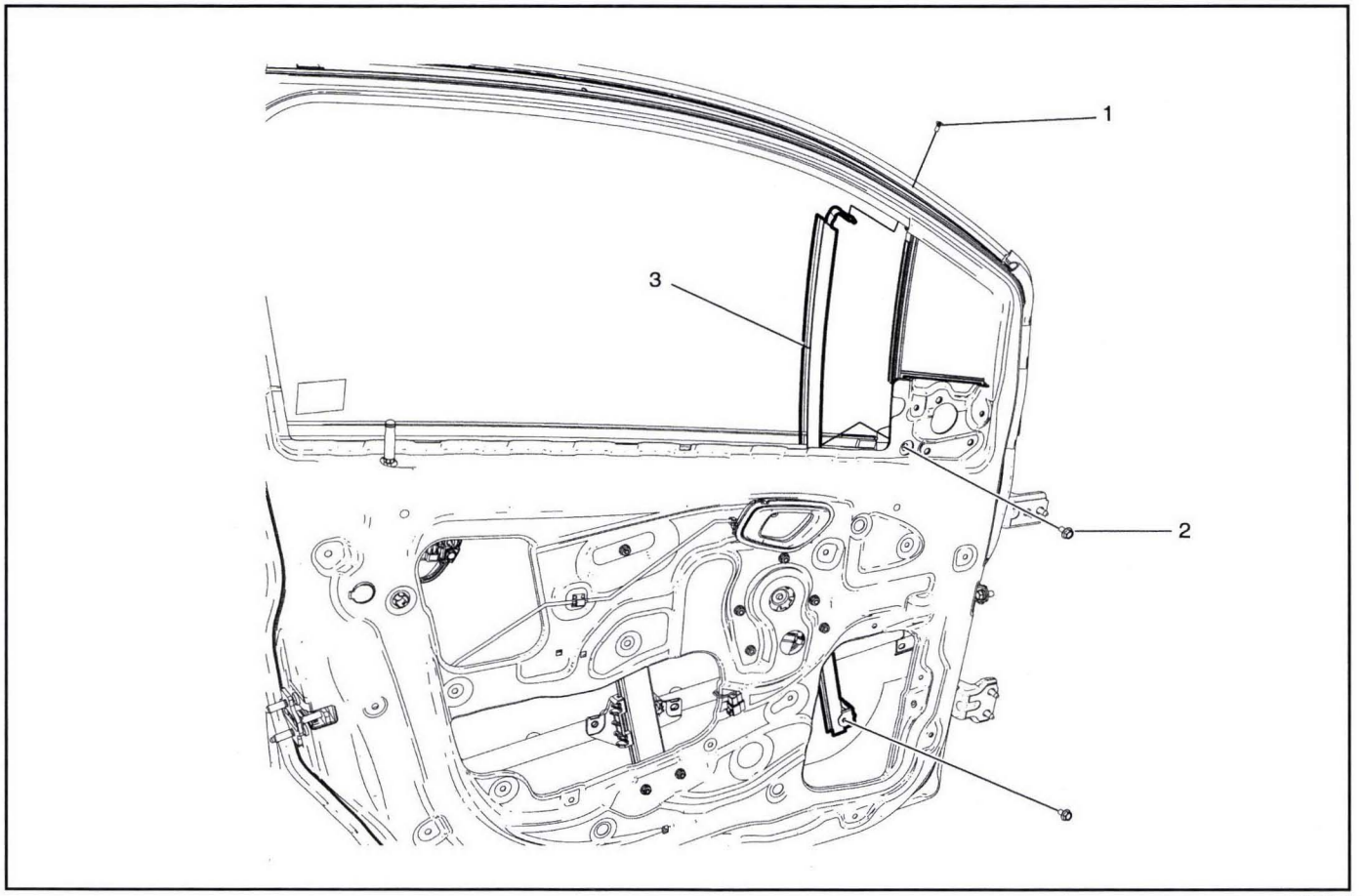
Warning: Insufficient curing of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.

- ***For the moisture-curing type of urethane adhesive, allow a minimum of 6 hours at 21°C (70°F) or greater and with at least 30 percent relative humidity. Allow at least 24 hours for the complete curing of the urethane adhesive.***
- ***For the chemical-curing type of urethane adhesive, allow a minimum of 1 hour.***

Do NOT physically disturb the repair area until after these minimum times have elapsed.

18. Maintain the following conditions in order to properly cure the urethane adhesive by manufacturers instructions:
    - Partially lower a door window in order to prevent pressure buildups when closing doors before the urethane adhesive cures.
    - Do not drive the vehicle until the urethane adhesive is cured. Refer to the instructions of the manufacturers curing times.
    - Do not use compressed air in order to dry the urethane adhesive.
19. Install the rear spoiler. Refer to *Rear End Spoiler Replacement on page 2-17*.
20. Install the rear window wiper arm. Refer to *Rear Window Wiper Arm Replacement on page 4-329*.
21. Connect the liftgate window defogger electrical connectors to the bus bar.
22. Install the liftgate trim. Refer to *Liftgate Trim Finish Panel Replacement on page 2-70*.
23. Remove the double layer of masking tape around the perimeter of the painted surfaces and the interior trim.
24. Close the liftgate.

Front Side Door Window Channel Replacement

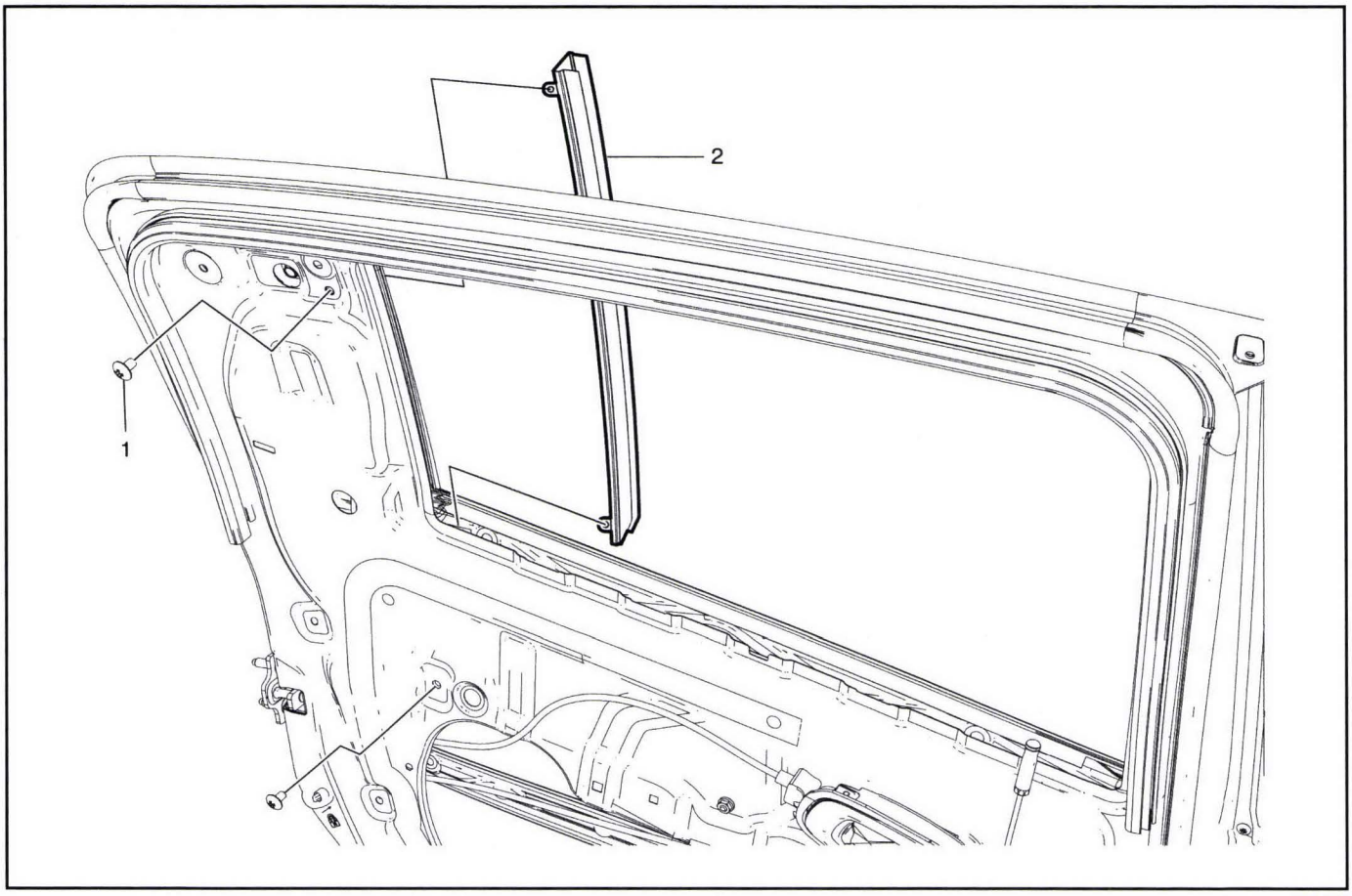


2327703

Front Side Door Window Channel Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the front side door window. Refer to *Front Side Door Window Replacement on page 4-31*. 2. Partially peel off the front side door window weatherstrip from the door window opening. Refer to *Front Side Door Window Weatherstrip Replacement on page 4-49*.	
1	Front Side Door Window Channel Screw **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 1.3 N•m (12 lb in)
2	Front Side Door Window Channel Bolt (Qty: 2) **Tighten** 8 N•m (71 lb in)
3	Front Side Door Window Channel Assembly

Rear Side Door Window Channel Replacement

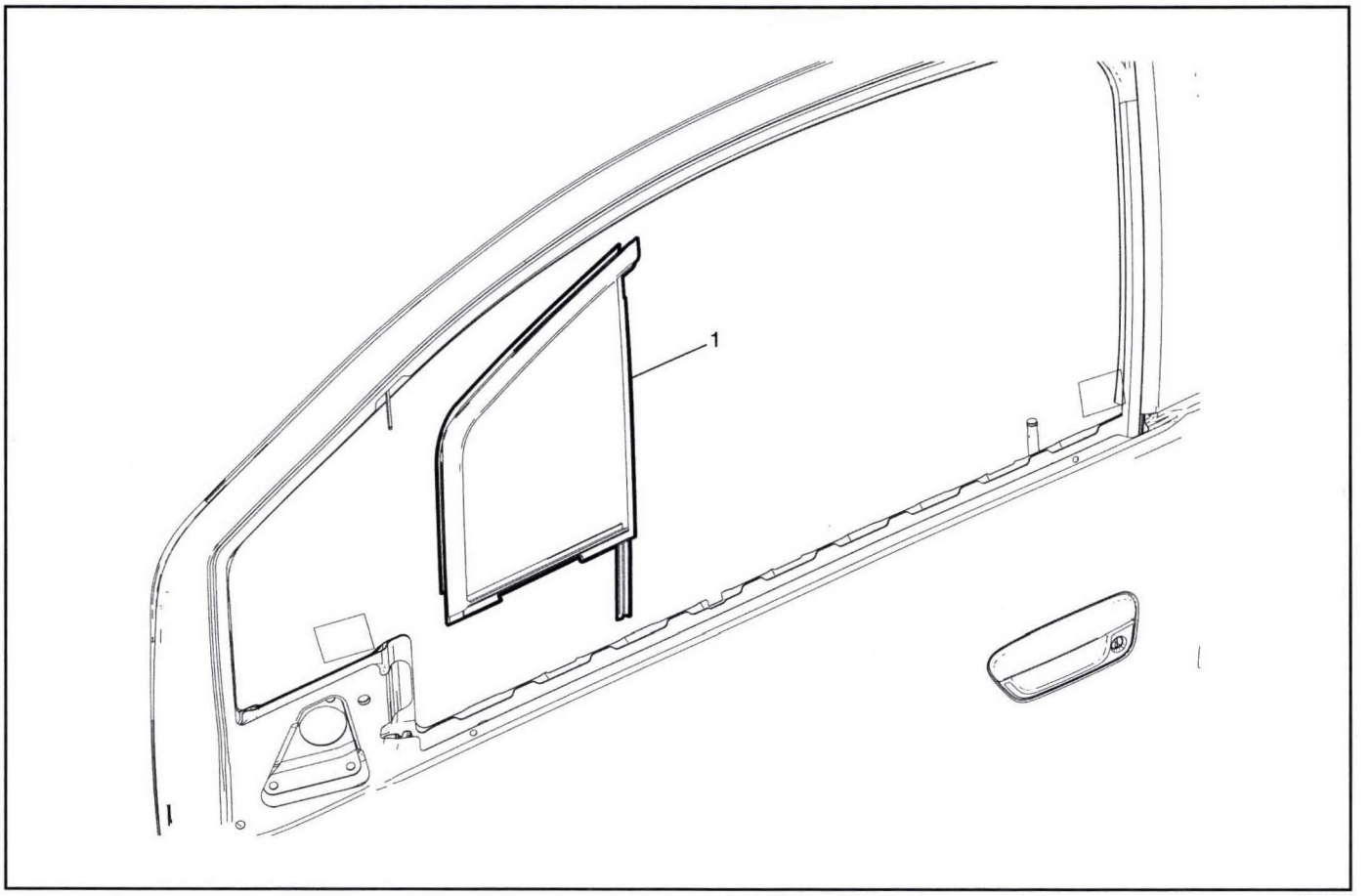


2327702

Rear Side Door Window Channel Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the rear side door window. Refer to *Rear Side Door Window Replacement on page 4-32*. 2. Partially peel off the rear side door window weatherstrip from the door window opening. Refer to *Rear Side Door Window Weatherstrip Replacement on page 4-50*.	
1	Rear Side Door Window Channel Screw (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 8 N•m (71 lb in)
2	Rear Side Door Window Channel Assembly

Front Side Door Stationary Window Replacement

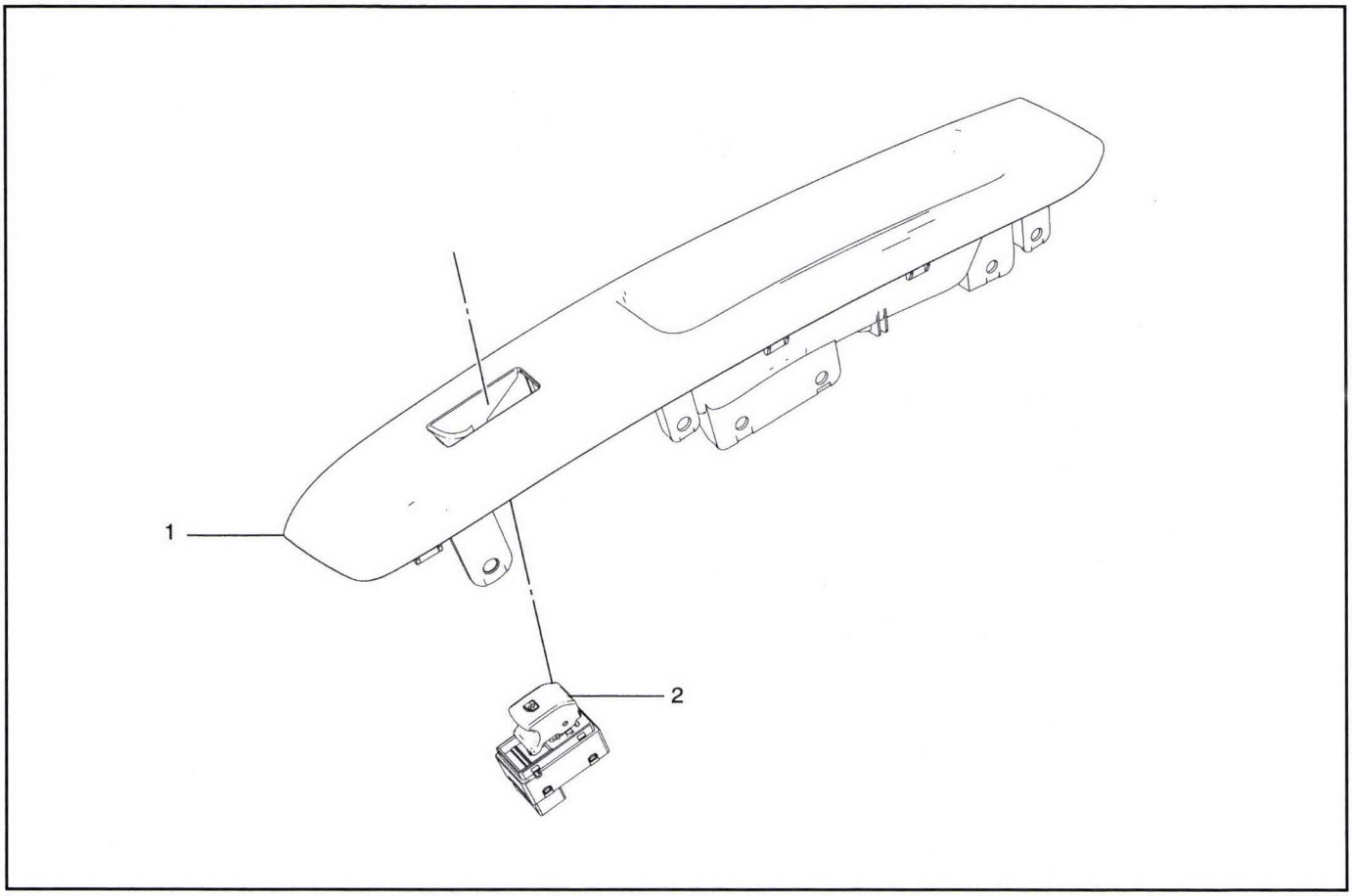


2309151

Front Side Door Stationary Window Replacement

Callout	Component Name
Preliminary Procedure 1. Remove the front side door window channel. Refer to *Front Side Door Window Channel Replacement on page 4-37*. 2. Remove the outside rearview mirror. Refer to *Outside Rearview Mirror Replacement on page 4-209*.	
1	Front Side Door Stationary Window Assembly

Front Side Door Window Switch Replacement - Right Side

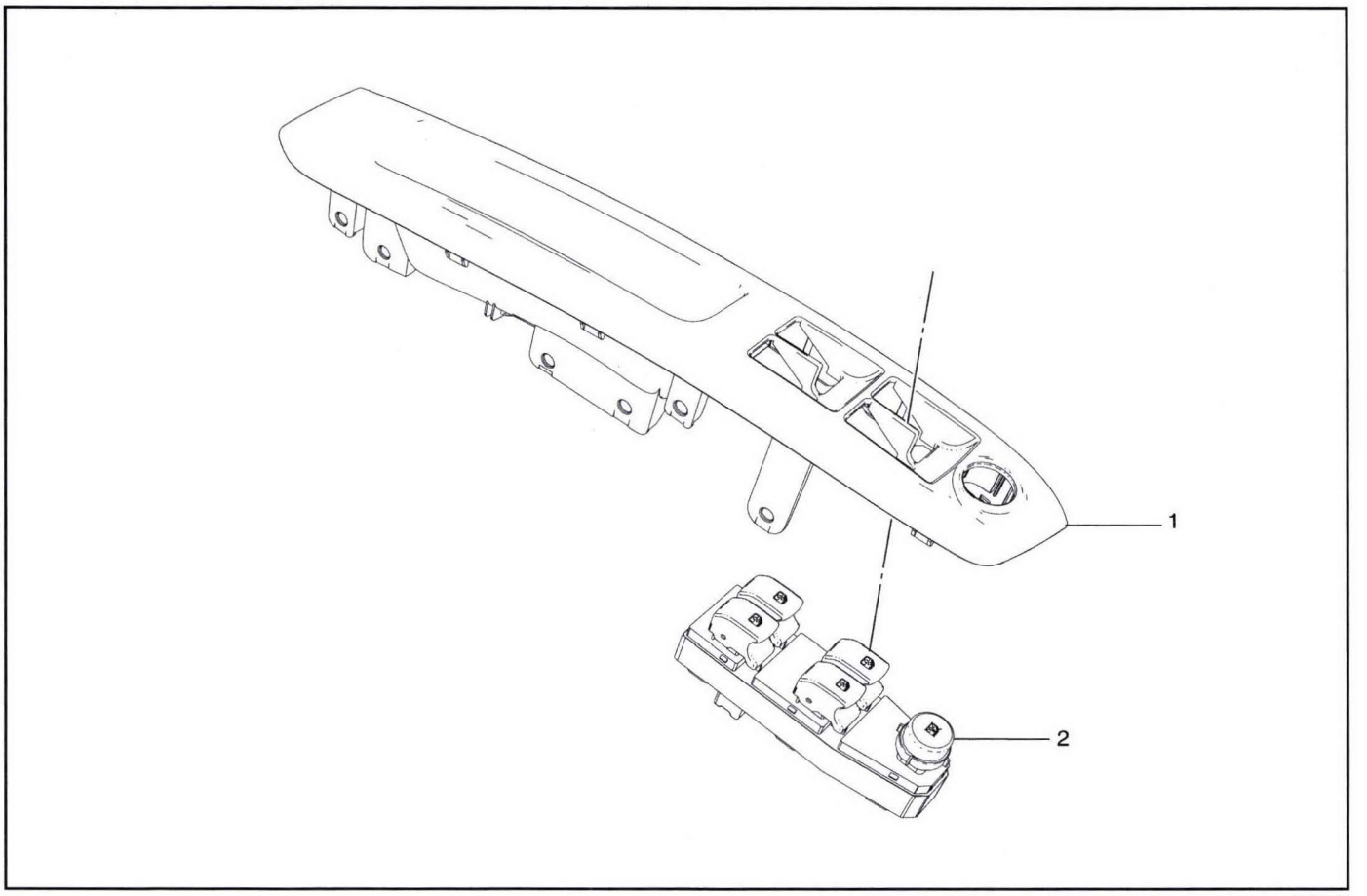


2327706

Front Side Door Window Switch Replacement - Right Side

Callout	Component Name
1	Front Side Door Armrest Switch Mount Plate Refer to *Front Side Door Armrest Switch Mount Plate Replacement on page 2-51*.
2	Front Side Door Window Switch Assembly **Procedure** Disconnect the electrical connector.

Front Side Door Window Switch Replacement - Left Side

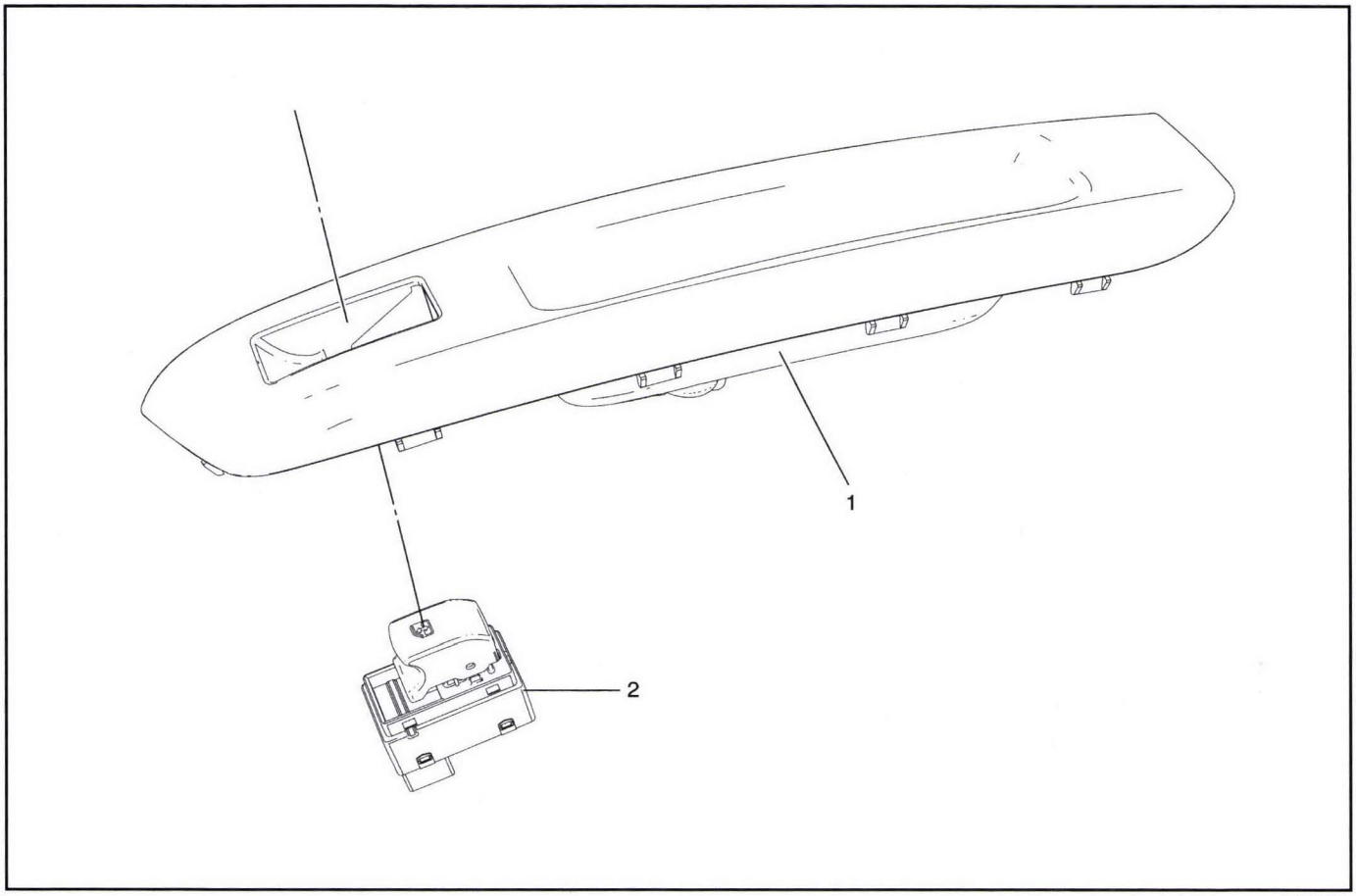


2327705

Front Side Door Window Switch Replacement - Left Side

Callout	Component Name
1	Front Side Door Armrest Switch Mount Plate Refer to *Front Side Door Armrest Switch Mount Plate Replacement on page 2-51*
2	Front and Rear Side Door Window Switch Assembly **Procedure** Disconnect the electrical connector.

Rear Side Door Window Switch Replacement

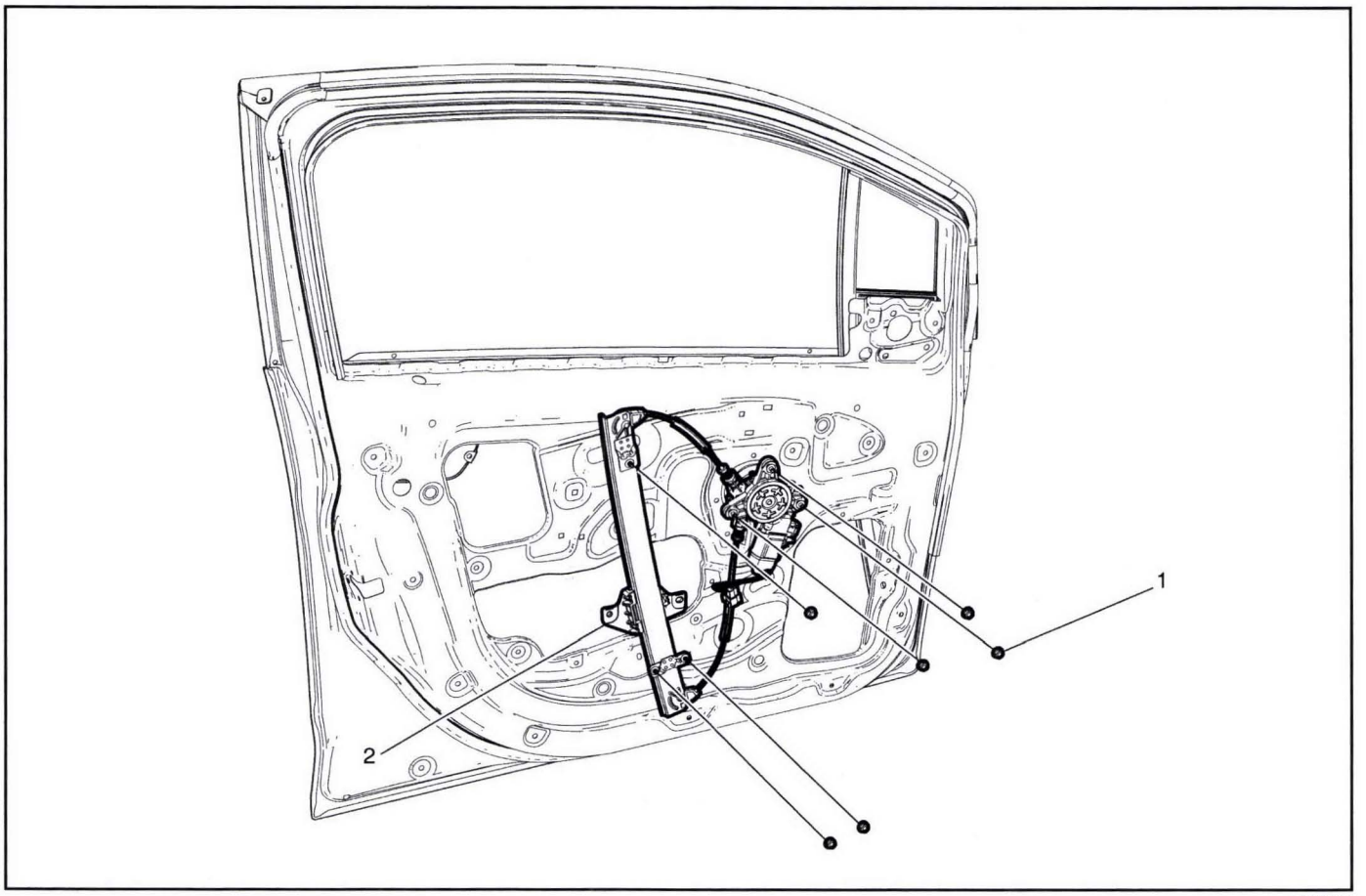


2327704

Rear Side Door Window Switch Replacement

Callout	Component Name
1	Rear Side Door Window Switch Bezel Refer to *Rear Side Door Window Switch Bezel Replacement on page 2-50*.
2	Rear Side Door Window Switch Assembly **Procedure** Disconnect the electrical connector.

Front Side Door Window Regulator Replacement

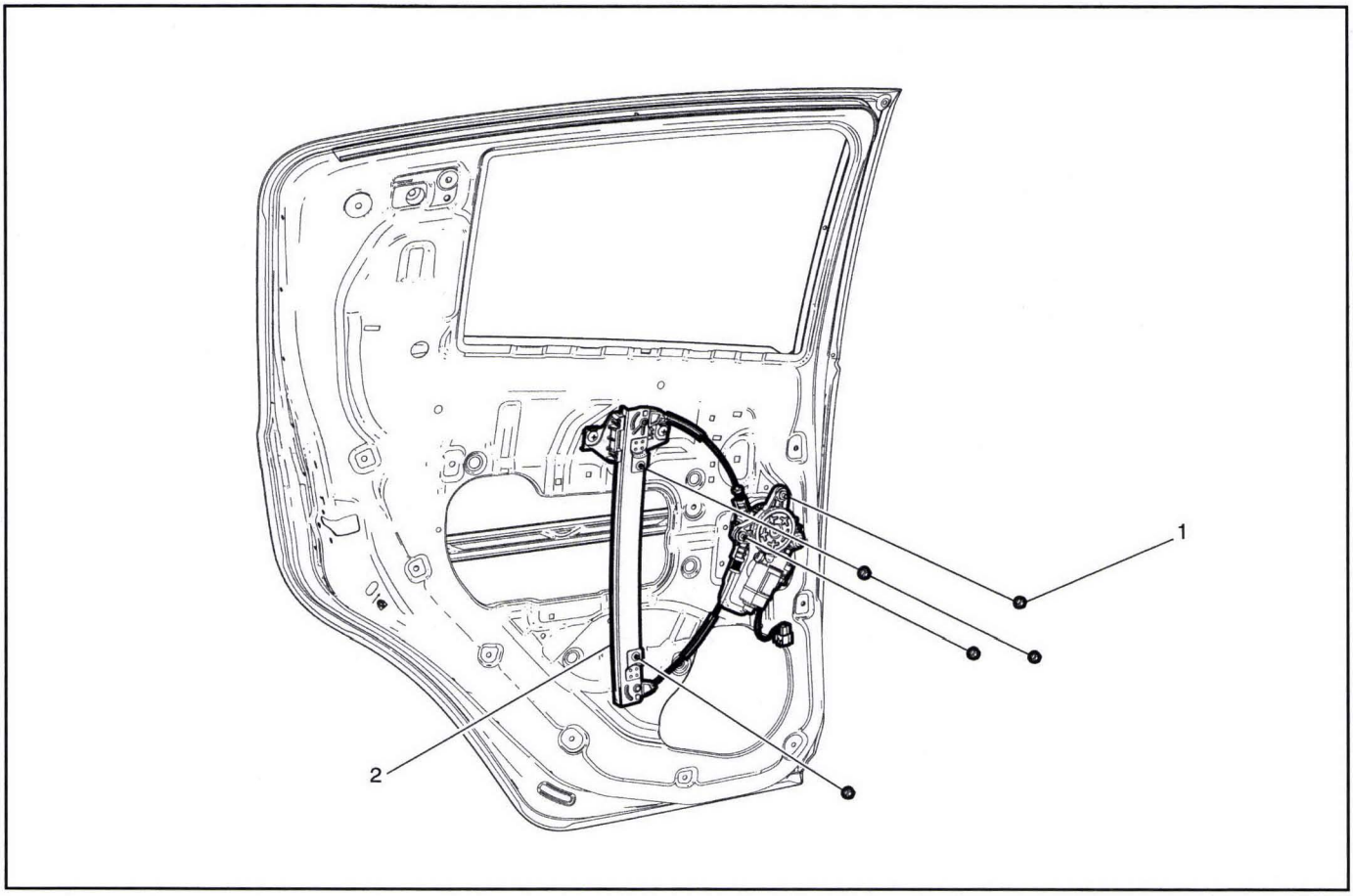


2309145

Front Side Door Window Regulator Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the front side door window regulator sash screw. Refer to *Front Side Door Window Replacement on page 4-31*. 2. After detaching window from regulator, manually move glass to full up position and securely tape off to window frame.	
1	Front Side Door Window Regulator Nut (Qty: 6) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 8 N•m (71 lb in)
2	Front Side Door Window Regulator Assembly

Rear Side Door Window Regulator Replacement

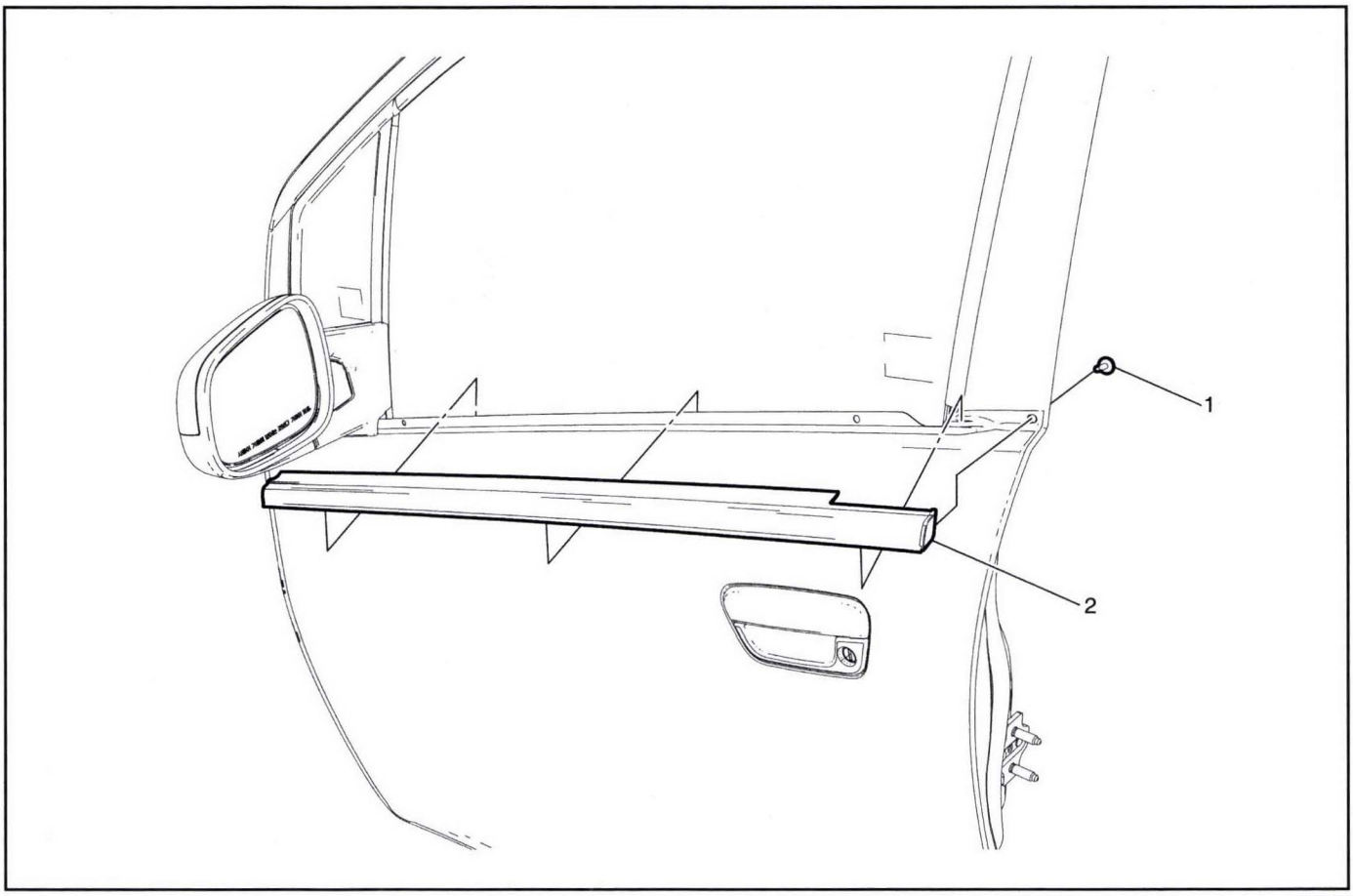


2309146

Rear Side Door Window Regulator Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the rear side door window regulator sash screws. Refer to *Rear Side Door Window Replacement on page 4-32*. 2. After detaching window from regulator, manually move glass to full up position and securely tape off to window frame.	
1	Rear Side Door Window Regulator Nut (Qty: 5) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 8 N•m (71 lb in)
2	Rear Side Door Window Regulator Assembly

Front Side Door Window Outer Sealing Strip Replacement

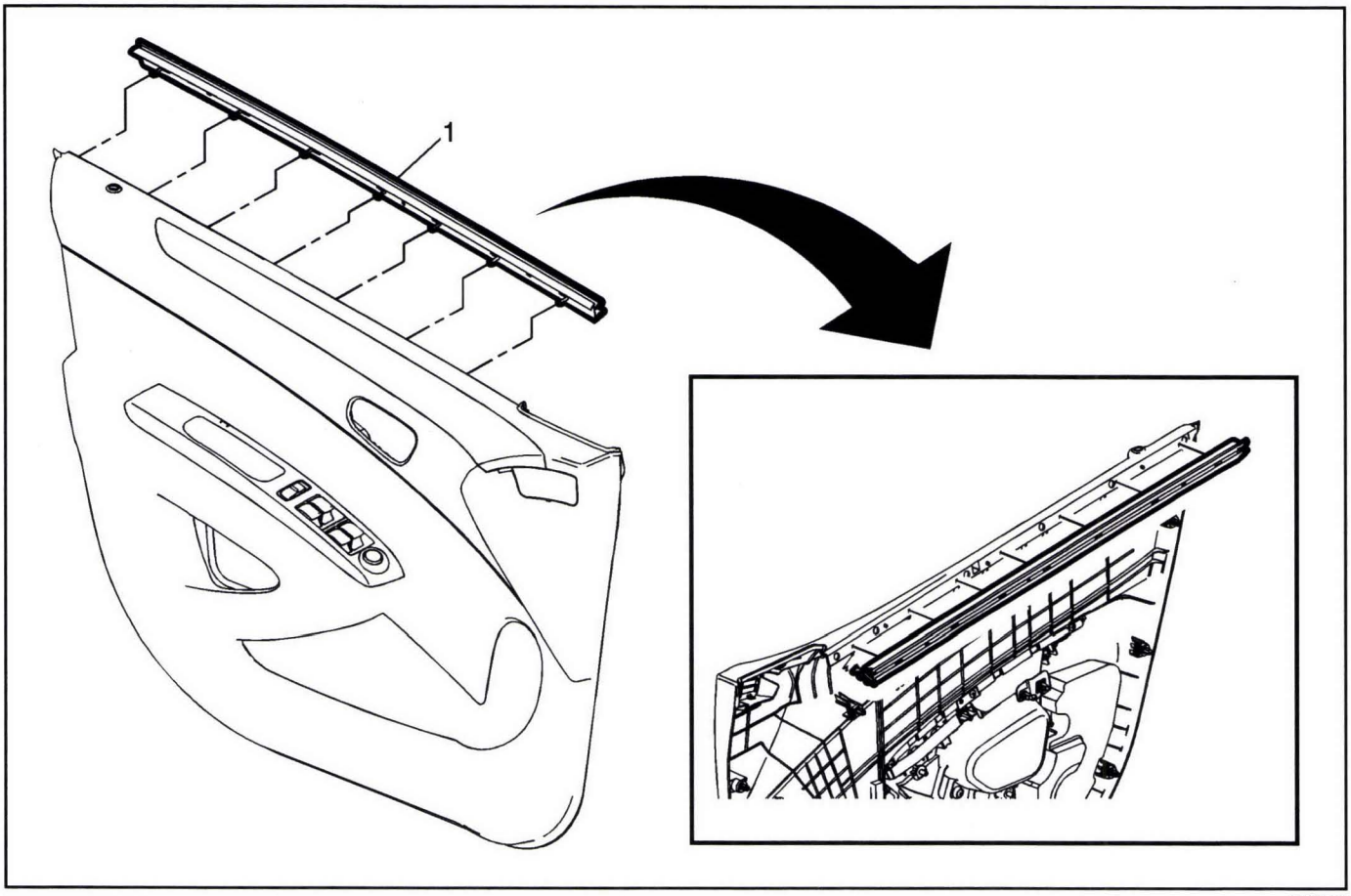


2309149

Front Side Door Window Outer Sealing Strip Replacement

Callout	Component Name
1	Front Side Door Window Outer Sealing Strip Screw (Qty: 1) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 2 N•m (18 lb in)
2	Front Side Door Window Outer Sealing Strip Assembly

Front Side Door Window Inner Sealing Strip Replacement

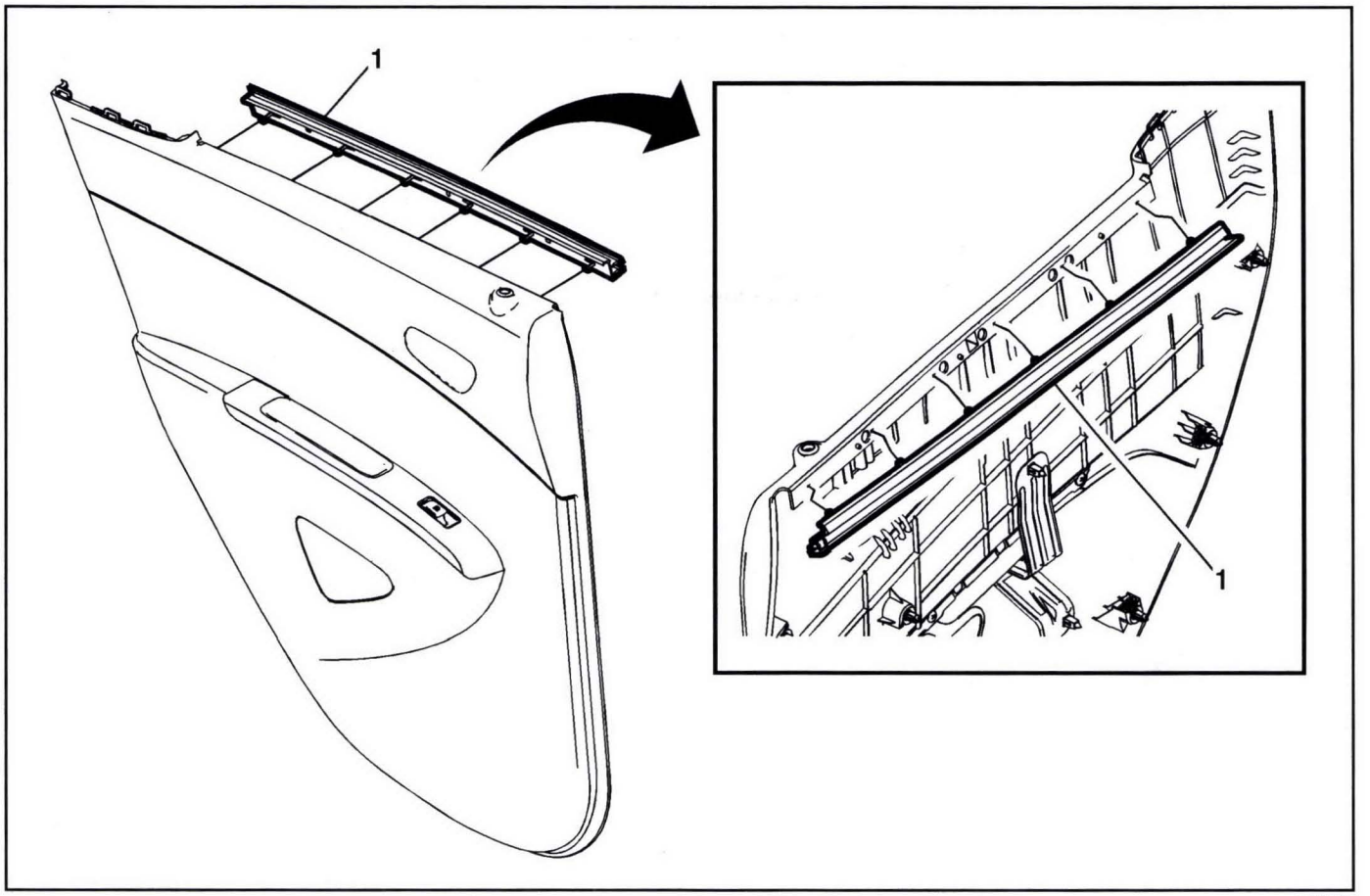


3038778

Front Side Door Window Inner Sealing Strip Replacement

Callout	Component Name
Preliminary Procedure 1. Remove the front side door trim. Refer to *Front Side Door Trim Replacement on page 2-53*. 2. Remove the front side door upper trim panel, if necessary. Refer to *Front Side Door Upper Trim Panel Replacement on page 2-52*.	
1	Front Side Door Window Inner Sealing Strip Assembly **Procedure** Pull outward to disengage sealing strip from door trim panel.

Rear Side Door Window Inner Sealing Strip Replacement

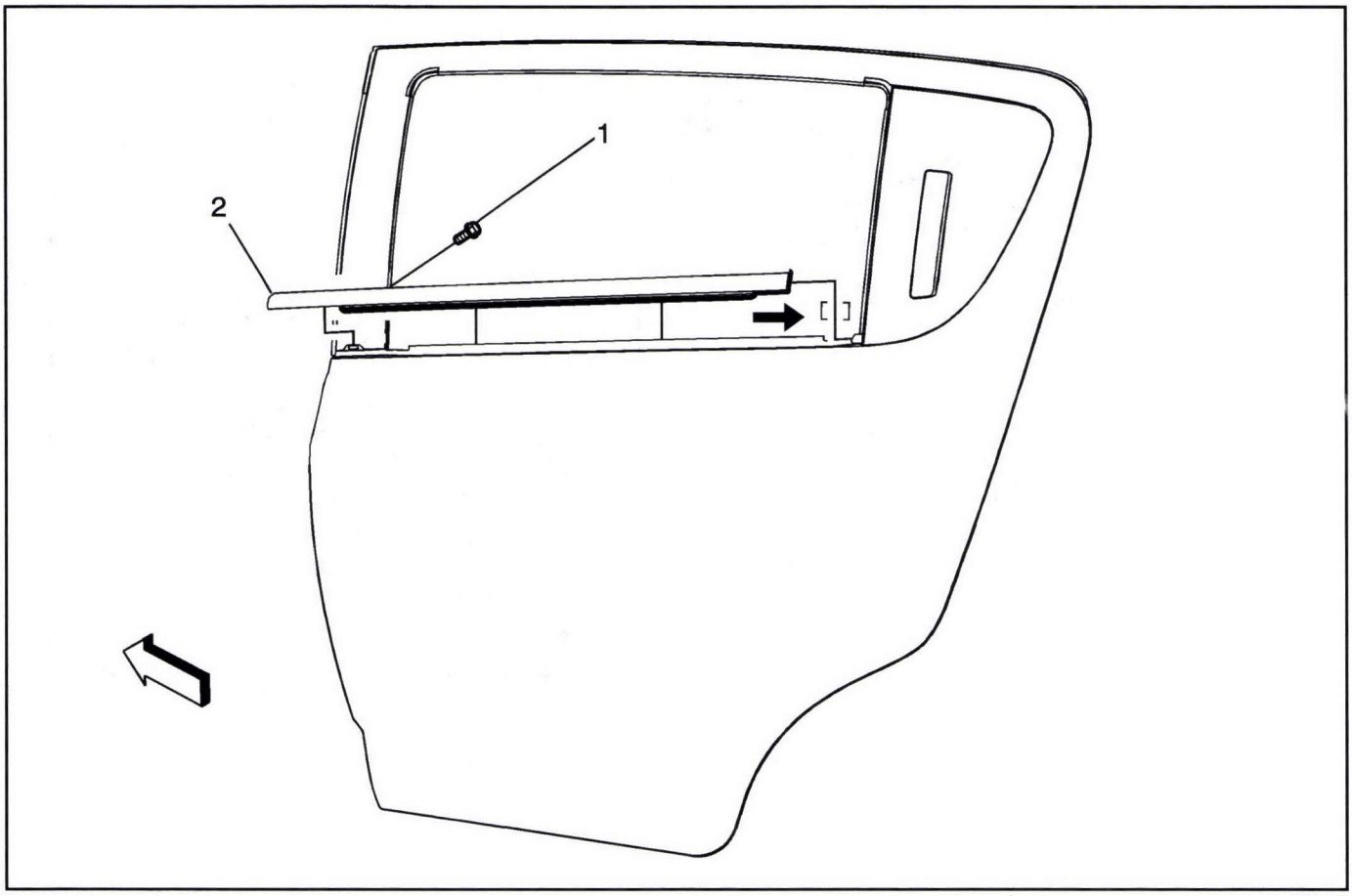


3212566

Rear Side Door Window Inner Sealing Strip Replacement

Callout	Component Name
Preliminary Procedure Remove the rear side door trim. Refer to *Rear Side Door Trim Replacement on page 2-68*.	
1	Rear Side Door Window Inner Sealing Strip Assembly **Procedure** Pull outward to disengage sealing strip from door trim panel.

Rear Side Door Window Outer Sealing Strip Replacement

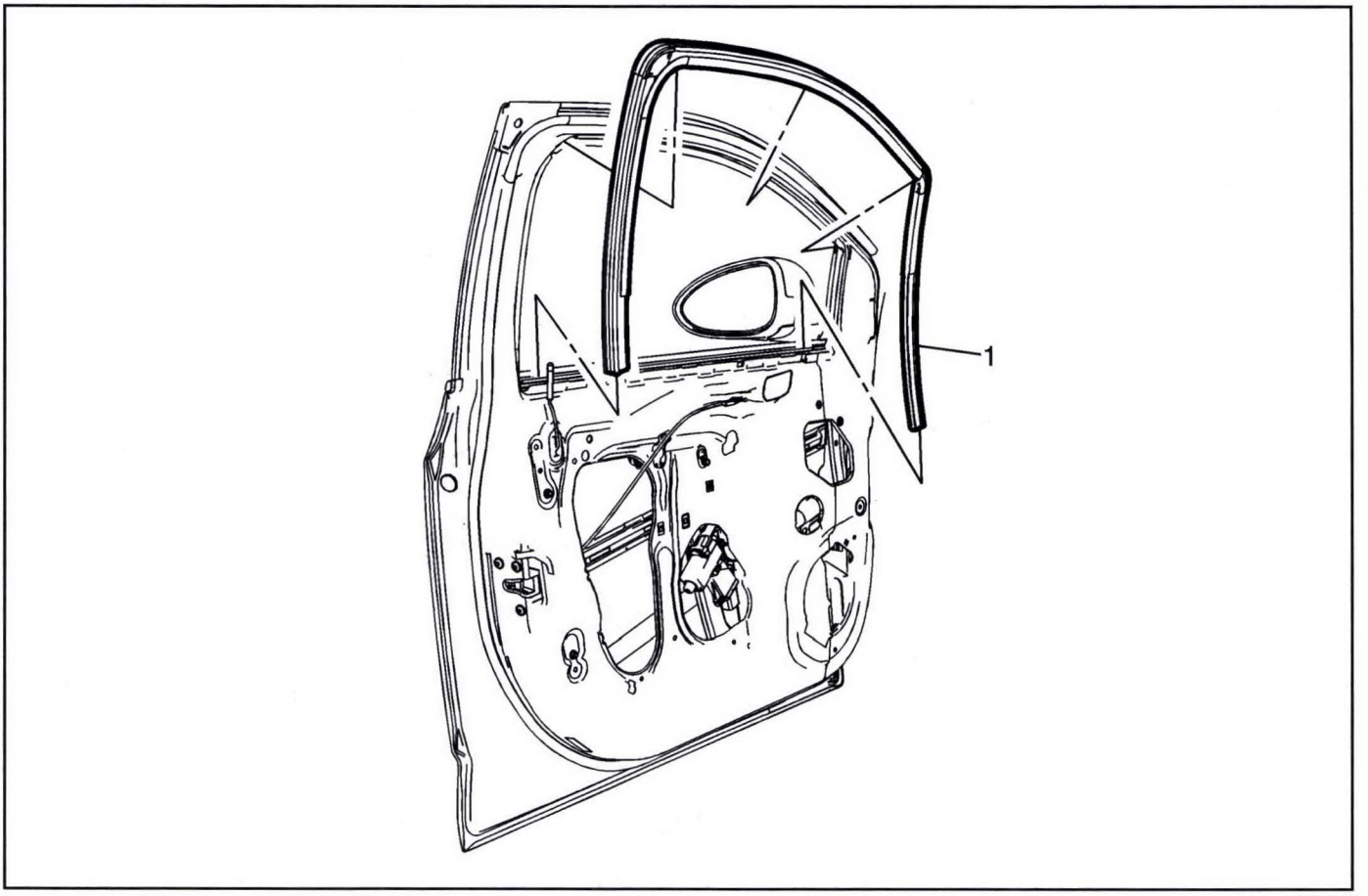


2425049

Rear Side Door Window Outer Sealing Strip Replacement

Callout	Component Name
1	Rear Side Door Window Outer Sealing Strip Screw **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 2 N•m (18 lb in) **Note:** Open the rear door to the full open position to expose the rear side door window outer sealing strip screw that is located on the front inner edge of the door.
2	Rear Side Door Window Outer Sealing Strip **Procedure** 1. Use the appropriate tool, lift the front corner of the sealing strip and pull upward and away from the door flange. 2. Press firmly to insert the rear side door window sealing strip back on the door flange. 3. Inspect the door window for proper operation before installing the door trim panel.

Front Side Door Window Weatherstrip Replacement

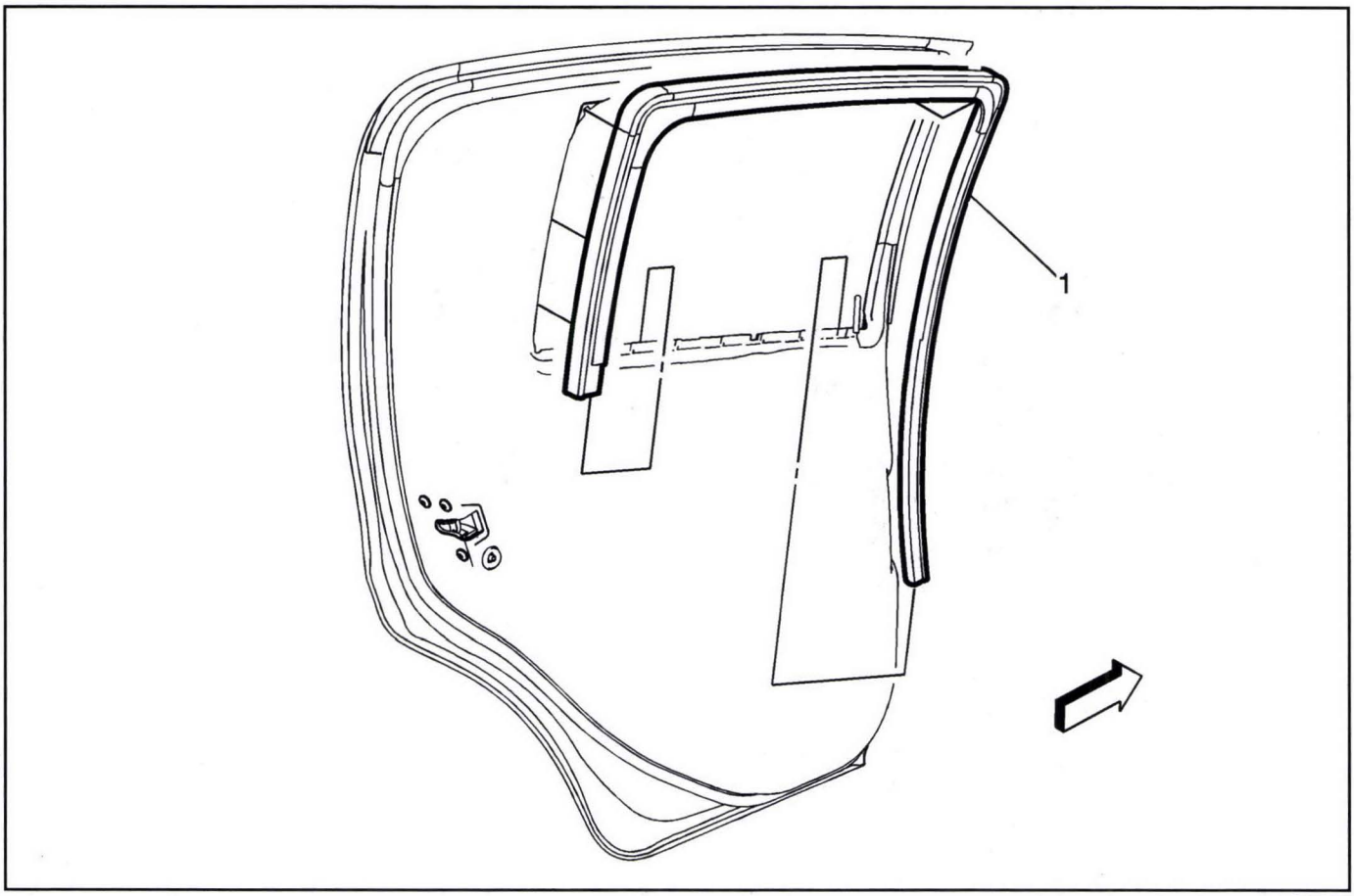


2425016

Front Side Door Window Weatherstrip Replacement

Callout	Component Name
Preliminary Procedures 1. Remove front side door trim panel. Refer to *Front Side Door Trim Replacement on page 2-53*. 2. Remove the front side door window. Refer to *Front Side Door Window Replacement on page 4-31*. 3. Remove the outer sealing strip. Refer to *Front Side Door Window Outer Sealing Strip Replacement on page 4-45*.	
1	Front Side Door Window Weatherstrip **Procedure** 1. Grasp both upper corners of the window weatherstrip, pull downward releasing the assembly from the door frame. 2. Insert the weatherstrip downward in the front and rear channel until fully seated. 3. Position the window weatherstrip in the upper rear corner of the frame, work the weatherstrip around the door frame. 4. Carefully move the regulator upward for short slow intervals, while ensuring that the window remains in the channels. 5. Inspect the door window for proper operation before installing the door trim panel.

Rear Side Door Window Weatherstrip Replacement



2476172

Rear Side Door Window Weatherstrip Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the rear side door window regulator. Refer to *Rear Side Door Window Regulator Replacement on page 4-44*. 2. After removing the rear side door window regulator, gentle lower the window into the door panel.	
1	Rear Side Door Window Weatherstrip **Procedure** 1. Remove the weatherstrip from the front and rear lower window guides. 2. Grasp both upper corners, pull downward releasing the weatherstrip from the door frame. 3. Insert the weatherstrip downward in the window guides until fully seated. 4. Carefully move the regulator upward for short slow intervals, while ensuring that the window remains in the guides. 5. Inspect the door window for proper operation before installing the door trim panel.

Description and Operation

Full-Cut Method Description

Note:

- If corrosion of the pinch-weld flange is present, or if sheet metal repairs or replacements are required, refinish the pinch-weld flange in order to present a clean, primer-only surface.
- If paint repairs are required, mask the flange bonding area, prior to applying the color coat, in order to provide a clean, primer-only surface.
- Appropriate materials for these primer applications are typically 2 component catalyzed products. Use materials such as BASF DE15®, DuPont 2610®, Sherwin-Williams PSE 4600 and NP70® and Martin-Semour 5120 ,5130® , PPG DP90LF SPIES/HECKER 3688/8590 – 3688/5150 – 4070/5090 STANDOX 11158/13320 – 14653/14980 products are approved for this application. Follow the manufacturer's directions for the mix, the application, and the drying times.
- After repairing the opening as indicated, shake the pinch-weld primer black #3 well. Using a new dauber, apply the primer to the primed surface of the flange in the bonding area. Allow the primer to dry for 10 minutes.

Use only the full cut method, also known in the field as full strip method, when installing windows.

This method includes the following:

- The replacement of a majority of the urethane adhesive bead. Remove all but approximately 2 mm (3/64 in) of the existing bead of urethane adhesive from the pinch-weld flange.
- Apply pinch-weld primer to any exposed painted areas on the pinch-weld flange.

No mounds or loose pieces of urethane adhesive should remain on the pinch-weld flange. Do not remove all traces of urethane adhesive.

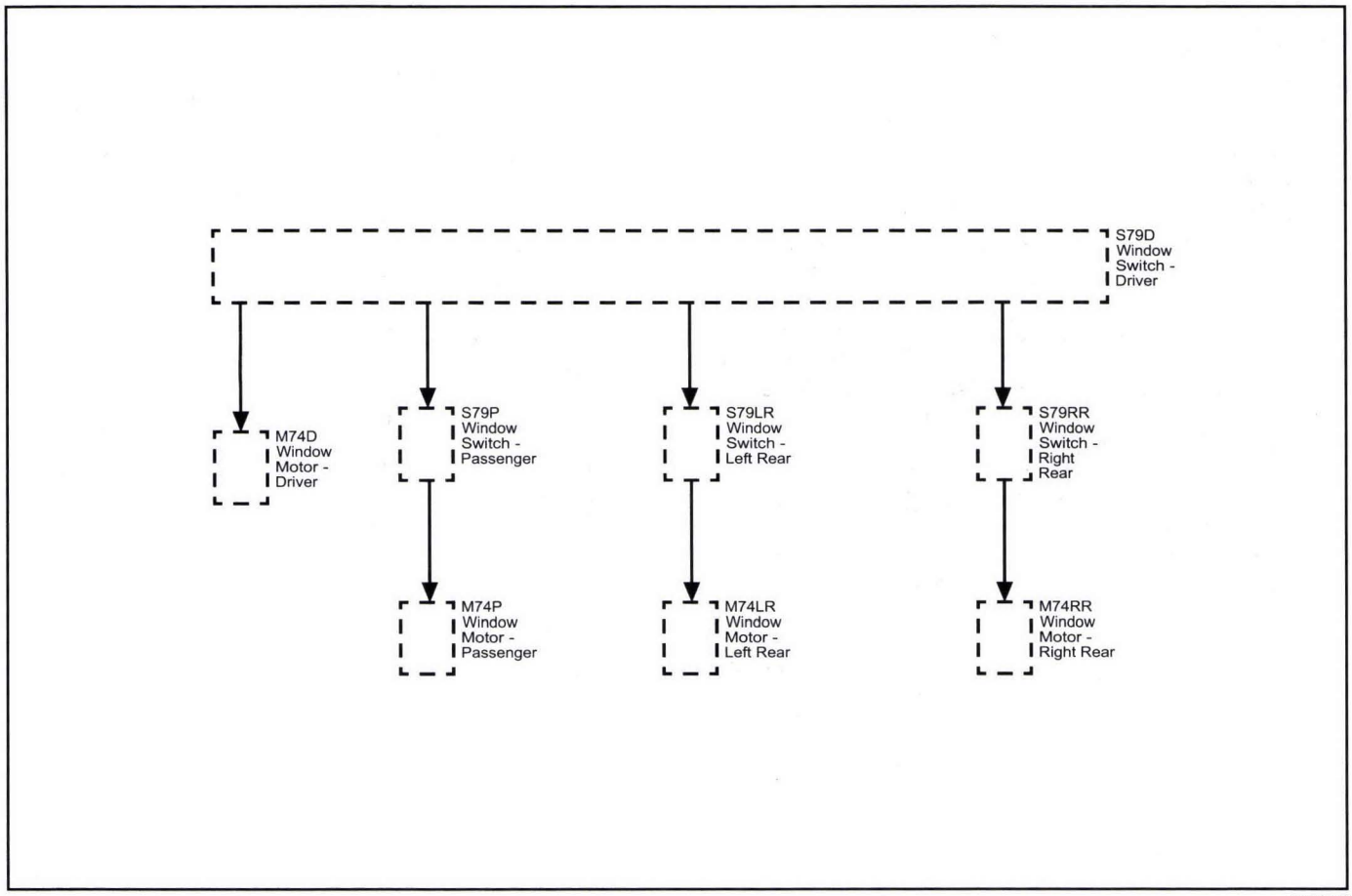
Power Windows Description and Operation

Power Window System Components

The power window system consists of the following components:

- Driver window switch
- Front passenger window switch
- Left rear window switch
- Right rear window switch
- Window regulator motors in each of the doors
- 30 amp fuse
- 25 amp fuse

14 Power Windows A55-A33-A66 Block Diagram



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Power Window System Controls

The power window system can be controlled by a power window up or down switch activation.

Window Operation and the Driver Window Switch

When the ignition switch is in the RUN or ACCY position, or Retained Accessory Power (RAP) is enabled, battery positive voltage is supplied to the driver window switch. Ground for the switch is provided by a ground circuit connected to a ground stake. When the driver window switch is pressed in the down position, the voltage is applied to the driver window motor down circuit and ground is applied to the driver window motor up circuit causing the window to open. When the driver window switch is pressed in the up position, the polarity is reversed, voltage and ground are applied to the opposite circuits and the window closes. In order to control the passenger windows from the driver door, the driver window switch assembly contains a separate window switch for each passenger door window. These window switches operate in the same way as the driver window switch, except that the applied voltage and ground must also pass through the local passenger, left rear or right rear window switch in order to command the respective window motor.

The driver window switch also provides power and ground for the local rear window switches. Battery positive voltage is supplied, through the power window master switch lockout signal circuit, to each local rear window switch. The local front passenger door window switch has a separate battery positive voltage circuit, however, this circuit is spliced into the driver window switch voltage supply circuit within the IP Fuse Block. Ground for all three of the passenger door switches, is also supplied by the driver window switch.

Lockout Switch Feature

The driver window switch contains a rear window lockout switch which disconnects the battery positive voltage supply to the remote rear passenger door window switches, disabling them. The local front passenger door window switch cannot be locked out.

Window Operation and the Passenger Window Switches

When the ignition switch is in the RUN or ACCY position, or Retained Accessory Power (RAP) is enabled, battery positive voltage is supplied to each of the remote passenger door window switches. When a local window switch is pressed in the down position, voltage is applied to the window motor down circuit and ground is applied to the window motor up circuit, causing the window to open. When the window switch is pressed in the up position, the polarity is reversed, voltage and ground are applied to the opposite circuits, and the window closes.

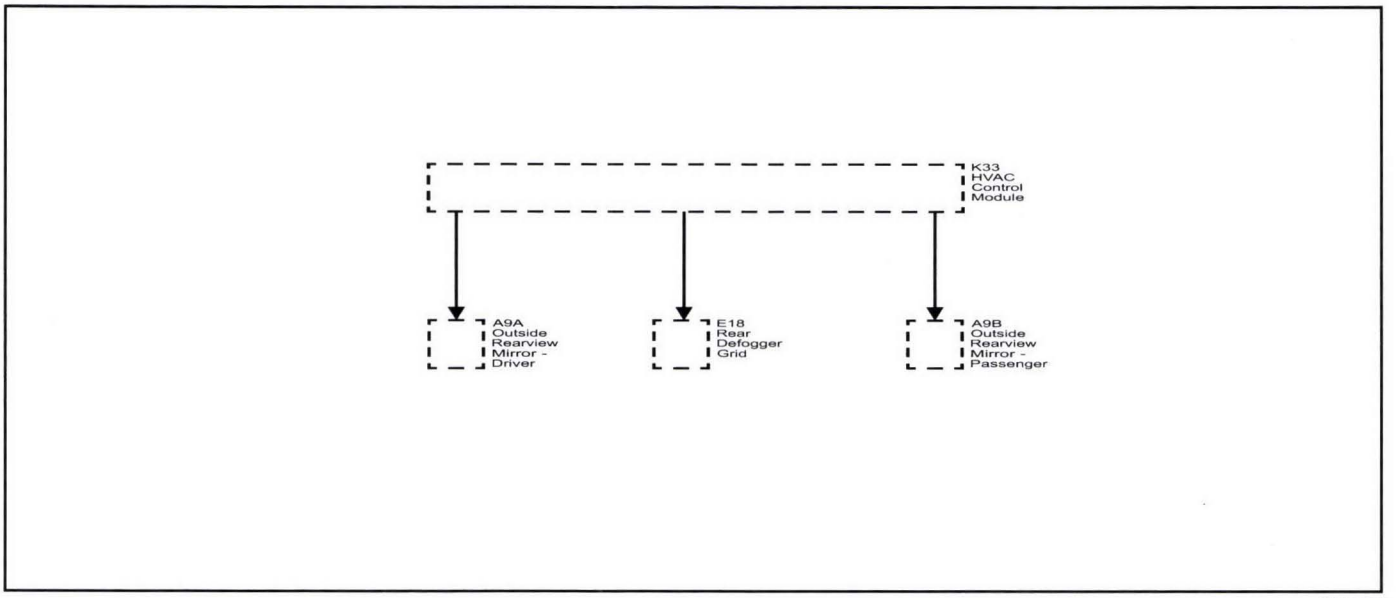
Rear Window Defogger Description and Operation

Rear Window Defogger System Components

The rear window defogger system consists of the following components:

- HVAC control module
- Rear defogger relay
- Rear defogger grid
- 40A fuse

Rear Window Defogger Block Diagram



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Rear Window Defogger Operation

The rear defog control system utilizes a single zone backlight design, driven with a single relay configuration. Additionally, up to two outside rear view mirrors can be heated if equipped. A switch for the customer to control the system is provided within the HVAC control module, also included in the HVAC control module is an indicator to inform the customer with the current state of the system. The system is only operational when engine is running or during remote start.

Pressing the heated rear window switch on the HVAC control module causes the HVAC control module to provide voltage to the coil side of the rear defogger relay, this will energize the relay causing the relay switch contacts to close allowing B+ voltage to flow through the rear defogger grid control circuit to the rear defogger grid.

When the rear heated window switch is pressed and the engine is running, the rear defog control system will remain active for 10 minutes. After the initial cycle has lapsed, pressing the switch again will continue rear window defogger operation, but the cycle will only last 5 minutes.

Stationary Window Description

Warning: Refer to Cracked Window Warning on page 0-4.

Stationary windows consist of all the windows on the vehicle which are immovable within its frame, such as the windshield, the rear window, and the inside rearview mirror.

Urethane Adhesive Description

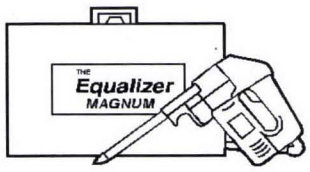
For replacement of any adhesive-installed window, use the full cut method only.

Use an adhesive that is approved by GM, Specification GMW-15672.

Use these materials based on specific manufacturer. Do NOT intermix primers or adhesives from one manufacturer to another.

Always follow the system manufacturers instructions for application, handling, and curing.

Special Tools and Equipment

Illustration	Tool Number/ Description
 3905	BO-39032 J-39032 Stationary Glass Removal Tool

Horns

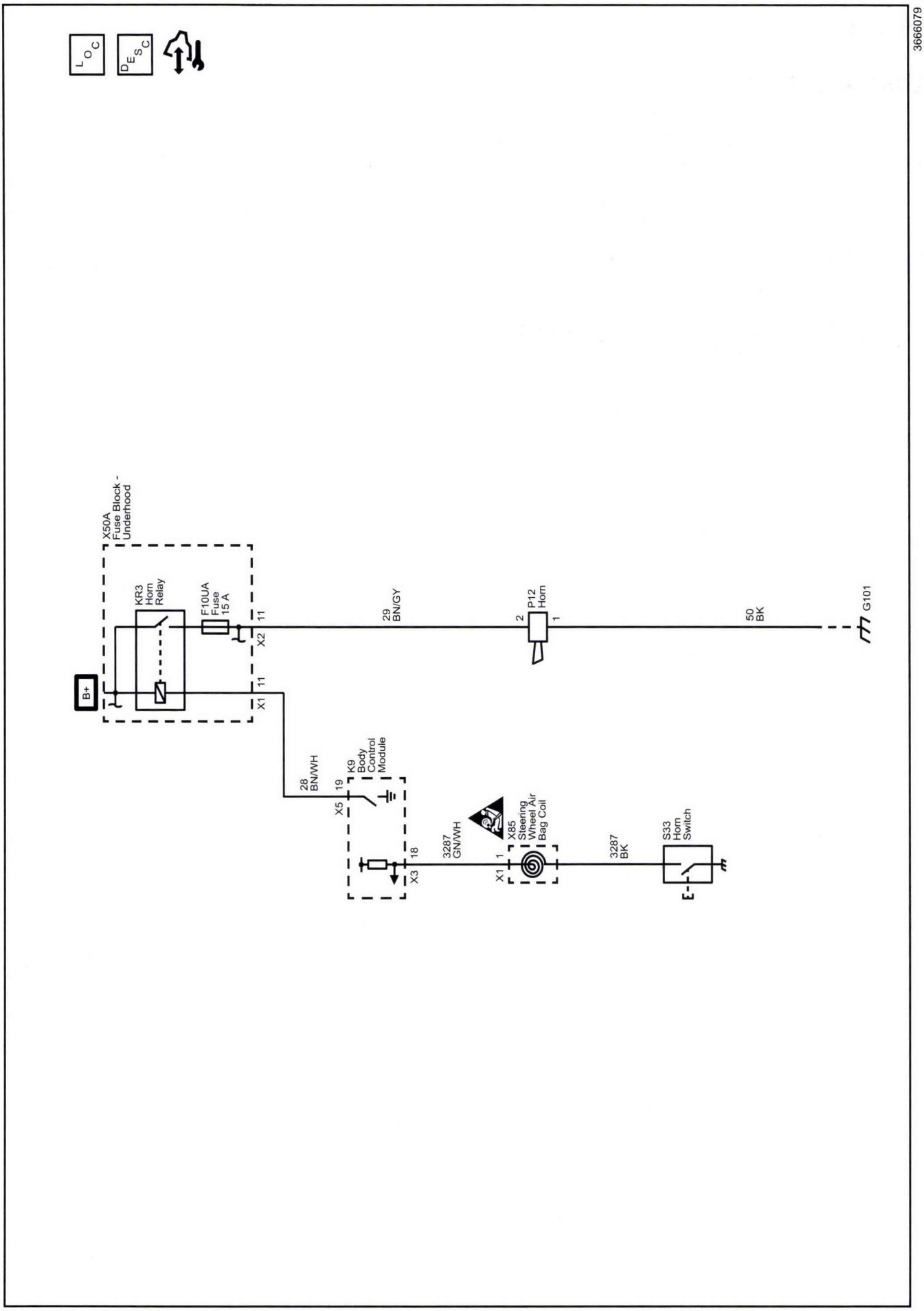
Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Horn Bolt	21 N•m	16 lb ft
Steering Wheel Horn Contact Spring Retainer Bolt	8 N•m	71 lb in

Schematic and Routing Diagrams

Horn Schematics (Horn)



Diagnostic Information and Procedures

DTC B2750

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B2750: Horn Relay Secondary Circuit

For symptom byte information refer to: *Symptom Byte List on page 6-117*

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	B2750 02	B2750 04	B2750 01	—

Circuit/System Description

The body control module provides a ground for the horn printed circuit board relay within the underhood fuse block. The underhood fuse block will then provide B+ voltage to the horn control circuit, sounding the horn.

Conditions for Running the DTC

When the horn output is actively being requested by the body control module.

Conditions for Setting the DTC

B2750 01

The body control module detects a short to voltage in the horn relay control circuit.

B2750 02

The body control module detects a short to ground in the horn relay control circuit.

B2750 04

The body control module detects an open/high resistance in the horn relay control circuit.

Action Taken When the DTC Sets

The body control module will command the horn when requested but the horn will be inoperative.

Conditions for Clearing the DTC

- The DTC clears when the fault is no longer detected.
- The current DTC will become history when the request for the output is removed.
- The history DTC will clear after 50 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Horn Schematics on page 4-56

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Horns System Description and Operation on page 4-64

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the operation of the P12 Horn when commanding the Horn Relay On and Off with a scan tool.

⇒ **If the P12 Horn is always ON or always OFF**

Refer to Circuit/System Testing.

⇓ **If the P12 Horn turns ON and OFF**

3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, Vehicle in Service Mode.
2. Verify the P12 Horn is not activated.

⇒ **If the P12 Horn is activated**

2.1. Vehicle OFF, disconnect the X1 harness connector at the X50A Fuse Block-Underhood.

2.2. Test for infinite resistance between the K9 Body Control Module control circuit terminal 19 X5 and ground.

⇒ If less than Infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the X50A Fuse Block-Underhood.

⇓ **If the P12 Horn is not activated**

3. Connect a 3 A fused jumper wire between the control circuit terminal 19 and ground.
4. Verify the P12 Horn activates.

⇒ **If the P12 Horn does not activate**

4.1. Vehicle OFF, remove the jumper wire, disconnect the X1 harness connector at the X50A Fuse Block-Underhood, Vehicle in Service Mode.

4.2. Test for less than 1 V between the K9 Body Control Module control circuit terminal 19 X5 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the X50A Fuse Block-Underhood.

⇓ **If the P12 Horn activates**

5. Replace the K9 Body Control Module.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for BCM replacement, programming and setup

Symptoms - Horns

Important: The following steps must be completed before using the symptom tables:

1. Perform *Diagnostic System Check - Vehicle on page 6-91* , before using the symptom tables in order to verify that all of the following are true:
   - There are no DTCs set
   - The control modules can communicate via the serial data link
2. Review the system operation in order to familiarize yourself with the system functions. Refer to *Horns System Description and Operation on page 4-64*.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the horn system. Refer to *Checking Aftermarket Accessories on page 11-871*.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Perform the following if a horn buzzes or has a harsh tone.
  - Inspect for debris in the joint where the horn fastens to the vehicle.
  - Test the torque of the horn mounting hardware. The horn mounting hardware should be tightened to a torque of 10 N•m (7 lb ft).

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to *Testing for Intermittent Conditions and Poor Connections on page 11-877*.

Symptom List

Refer to a symptom diagnostic procedure *Horns Malfunction on page 4-59* in order to diagnose the symptom.

Horns Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Horn Switch Signal	1	2	2	—
Horn Relay Control	1	B274F 04	2	—
Horn Control	2	2	1	—
Horn Ground	—	2	—	—
1. Horn Always On 2. Horn Inoperative				

Circuit/System Description

The body control module monitors the horn switch signal circuit, when the horn pad is pressed, the body control module detects the drop in the horn switch signal circuit and provides a ground for the horn PCB relay within the underhood fuse block. The underhood fuse block will then provide B+ voltage to the horn control circuit, sounding the horn

Diagnostic Aids

A short to ground in the horn relay control circuit or a short to voltage in the horn control circuit will cause the horns to sound continuously until the horns overheat and become inoperative.

Rotate the steering wheel while pressing the horn pad to identify intermittent and poor connections within the steering column.

If diagnosing a Horn- Poor Tone condition, inspect the following:

- Debris or water in the horn assembly
- Proper horn mounting hardware torque—Refer to *Fastener Tightening Specifications on page 4-55*.
- Debris in the joint where the horns attach to the vehicle
- Debris in direct contact with the horn
- Vehicle components vibrating while the horn is sounding

Reference Information

Schematic Reference

Horn Schematics on page 4-56

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Horns System Description and Operation on page 4-64

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Horn Switch parameter changes between Active and Inactive when pressing and releasing the horn pad.

⇒ **If the parameter does not change**

Refer to Circuit/System Testing — Horn Switch Malfunction.

⇓ **If the parameter changes**

3. Verify the P12 Horn turns ON and OFF and emit a clear and even tone when commanding the Horn Relay On and Off with a scan tool.

⇒ **If the P12 Horn does not turn ON and OFF**

Refer to Circuit/System Testing – Horns or Horn Command Malfunction.

⇒ **If the sound emitted is not clear and even**

Refer to Circuit/System Testing – Horn - Poor Tone.

⇓ **If the P12 Horn turns ON and OFF and emit a even and clear tone**

4. All OK.

Circuit/System Testing

Horn Switch Malfunction

Note: Refer to *SIR Service Precautions on page 12-152*.

1. Vehicle OFF, disconnect the X1 harness connector at the X85 Steering Wheel Air Bag Coil. Vehicle in Service Mode
2. Verify the scan tool Horn Switch parameter is Inactive.

⇒ **If not Inactive**

2.1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

2.2. Test for infinite resistance between the signal circuit terminal 1 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

3. Install a 3 A fused jumper wire between the signal circuit terminal 1 and ground.
4. Verify the scan tool Horn Switch parameter is Active.

⇒ **If not Active**

4.1. Vehicle OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.

4.2. Test for less than 1 V between the signal circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

4.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

5. Test or replace the S33 Horn Switch.

Horns or Horn Command Malfunction

1. Vehicle OFF and all vehicle systems OFF. Disconnect the harness connector at the P12 Horn. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Connect a test lamp between the control circuit terminal 2 and ground, Vehicle in Service Mode.
4. Verify the test lamp does not turn ON and OFF when commanding the Horn Relay On and Off with a scan tool.

⇒ **If the test lamp turns ON and OFF**

Test or replace the P12 Horn.

⇓ **If the test lamp does not turn ON and OFF**

5. Vehicle OFF, connect the harness connector at the P12 Horn. Disconnect the X2 harness connector at the X50A Fuse Block-Underhood, Vehicle in Service Mode.
6. Verify the P12 Horn is not activated.

⇒ **If the P12 Horn is activated**

6.1. Vehicle OFF, disconnect the harness connector at the P12 Horn, Vehicle in Service Mode.

6.2. Test for less than 1 V between the control circuit terminal 2 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, test or replace the P12 Horn.

⇓ **If the P12 Horn is not activated**

7. Connect a 15 A fused jumper wire between the control circuit terminal 11 X2 and B+.
8. Verify the P12 Horn activates.

⇒ **If the P12 Horn does not activate**

8.1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the P12 Horn, Vehicle in Service Mode.

8.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than Infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

8.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the P12 Horn.

⇓ **If the P12 Horn activates**

9. Vehicle OFF, connect the X2 harness connector at the X50A Fuse Block-Underhood. Disconnect the X5 harness connector at the K9 Body Control Module, Vehicle in Service Mode.

10. Verify the P12 Horn is not activated.

⇒ **If the P12 Horn is activated**

10.1. Vehicle OFF, disconnect the X1 harness connector at the X50A Fuse Block-Underhood.

10.2. Test for infinite resistance between the K9 Body Control Module control circuit terminal 19 X5 and ground.

⇒ If less than Infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the X50A Fuse Block-Underhood.

⇓ **If the P12 Horn is not activated**

11. Connect a 3 A fused jumper wire between the control circuit terminal 19 and ground.
12. Verify the P12 Horn activates.

⇒ **If the P12 Horn does not activate**

12.1. Vehicle OFF, remove the jumper wire, disconnect the X1 harness connector at the X50A Fuse Block-Underhood, Vehicle in Service Mode.

12.2. Test for less than 1 V between the K9 Body Control Module control circuit terminal 19 X5 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

12.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the X50A Fuse Block-Underhood.

⇓ **If the P12 Horn activates**

13. Replace the K9 Body Control Module.

Horn - Poor Tone

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the P12 Horn. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the high resistance in the circuit.

⇒ If less than 2 Ω, repair high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle OFF, disconnect the X12 harness connector at the X50A Fuse Block-Underhood.
4. Test for less than 2 Ω between the P12 Horn control circuit terminal 2 and the X50A Fuse Block-Underhood control circuit terminal 11 X2.

⇒ **If 2 Ω or greater**

Repair the high resistance in the control circuit.

⇓ **If less than 2 Ω**

5. Test or replace the P12 Horn.

Component Testing

Horn Test

1. Vehicle OFF, disconnect the harness connector at the P12 Horn.
2. Install a 15 A fused jumper wire between the control terminal 2 and 12 V. Install a jumper wire between the ground terminal 1 and ground.
3. Verify the P12 Horn turns ON and OFF

⇒ **If the P12 Horn does not turn ON and OFF**

Replace the P12 Horn.

⇓ **If the P12 Horn turns ON and OFF**

4. All OK

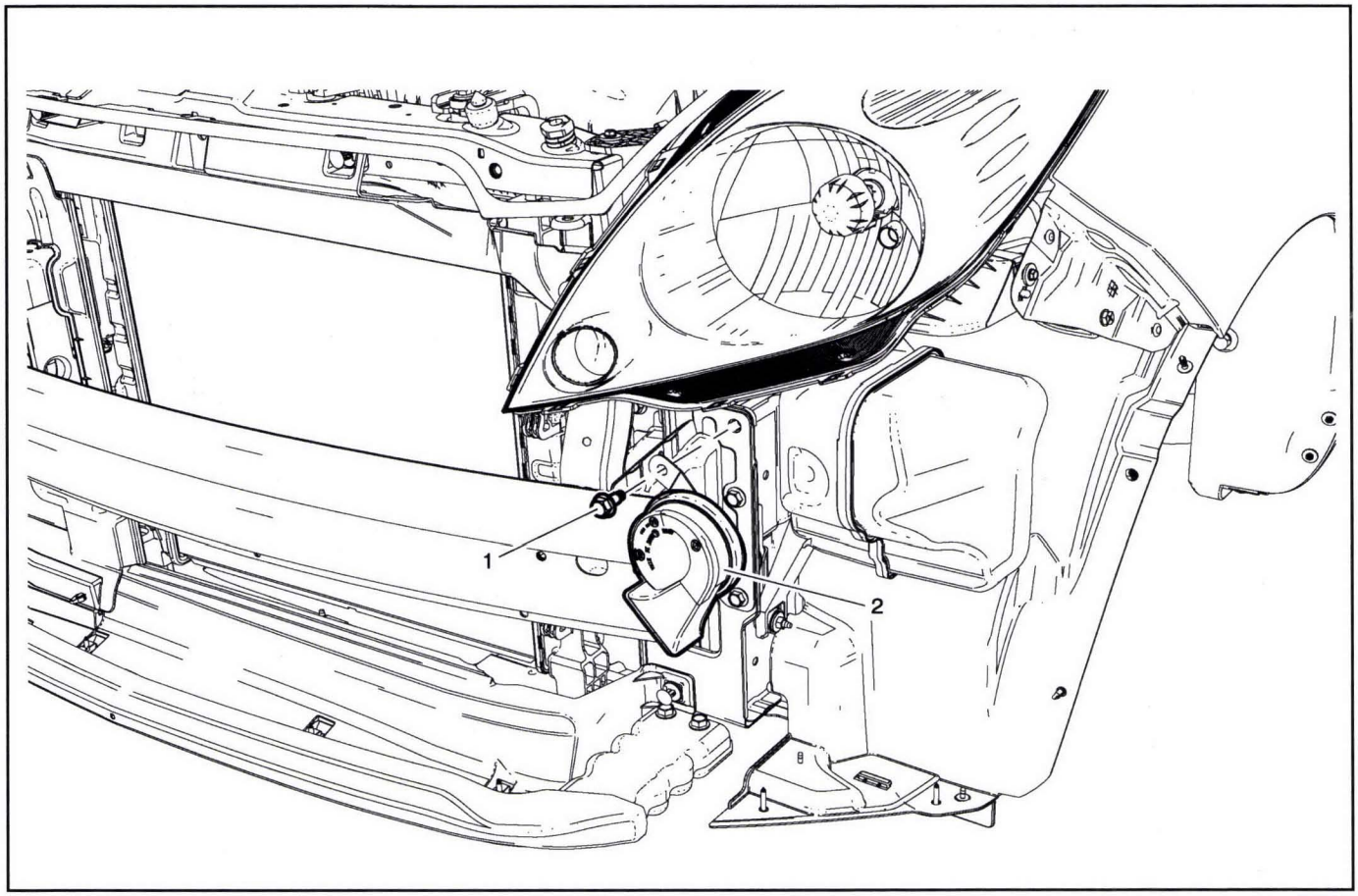
Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Horn Replacement on page 4-62*
- *Steering Wheel Horn Contact Replacement on page 4-63*
- *Control Module References on page 6-3* for body control module replacement, programming and setup

Repair Instructions

Horn Replacement



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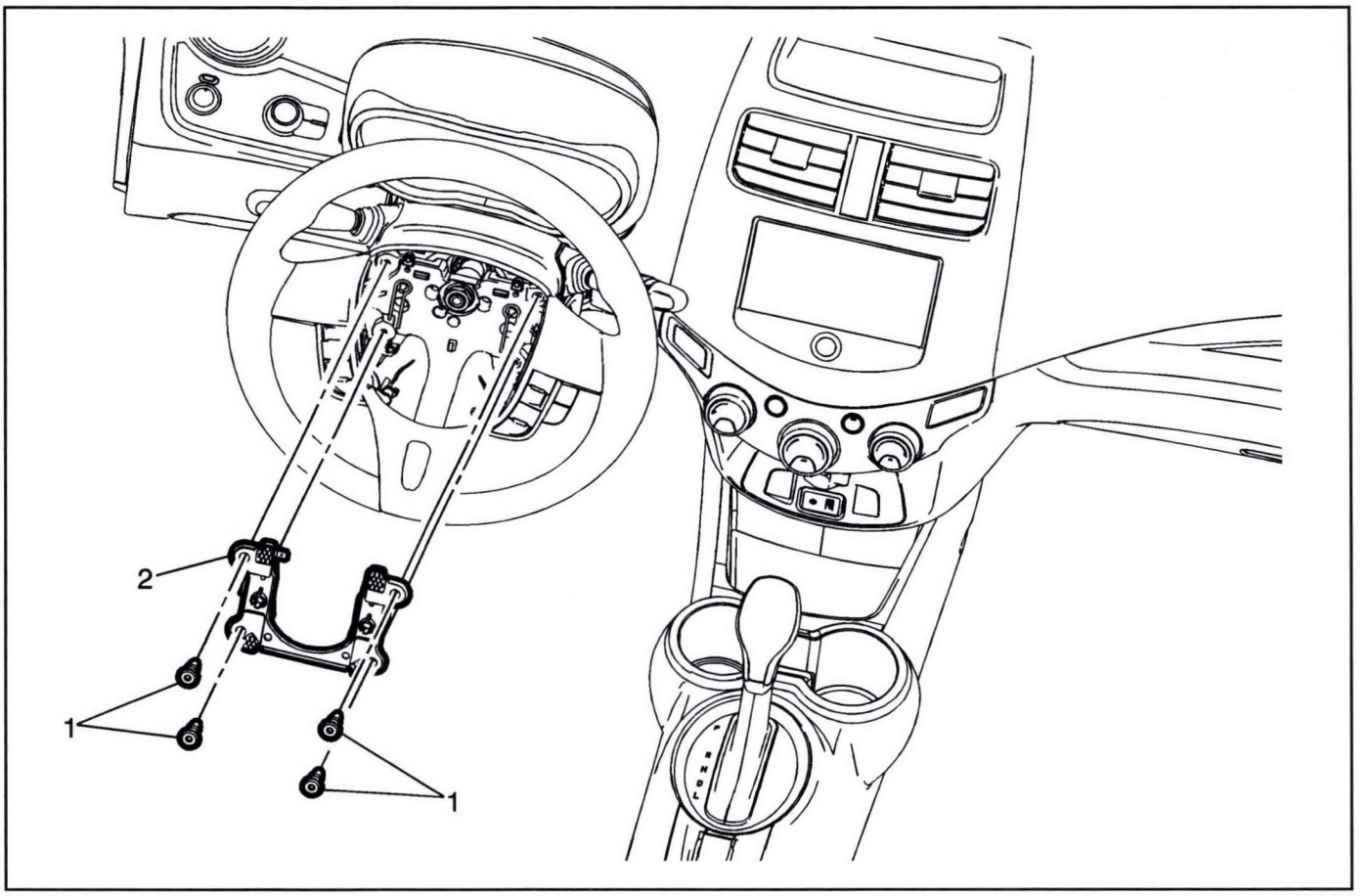
Horn Replacement

Callout	Component Name
Preliminary Procedure 1. Remove the tire and wheel. Refer to *Tire and Wheel Removal and Installation on page 15-51*. 2. Remove the left front wheel house liner. Refer to *Front Wheelhouse Liner Replacement - Left Side on page 3-139*.	
1	Horn Bolt (Qty: 1) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 21 N•m (16 lb ft)
2	Horn **Procedure** Disconnect electrical connectors.

Steering Wheel Horn Contact Replacement



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Steering Wheel Horn Contact Replacement

Callout	Component Name
Preliminary Procedure Remove the steering wheel airbag. Refer to *Steering Wheel Airbag Replacement on page 12-155*.	
1	Steering Wheel Horn Contact Spring Retainer Bolt (Qty: 4) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 8 N•m (71 lb in)
2	Steering Wheel Horn Contact **Procedure** Disconnect the electrical connections.

Description and Operation

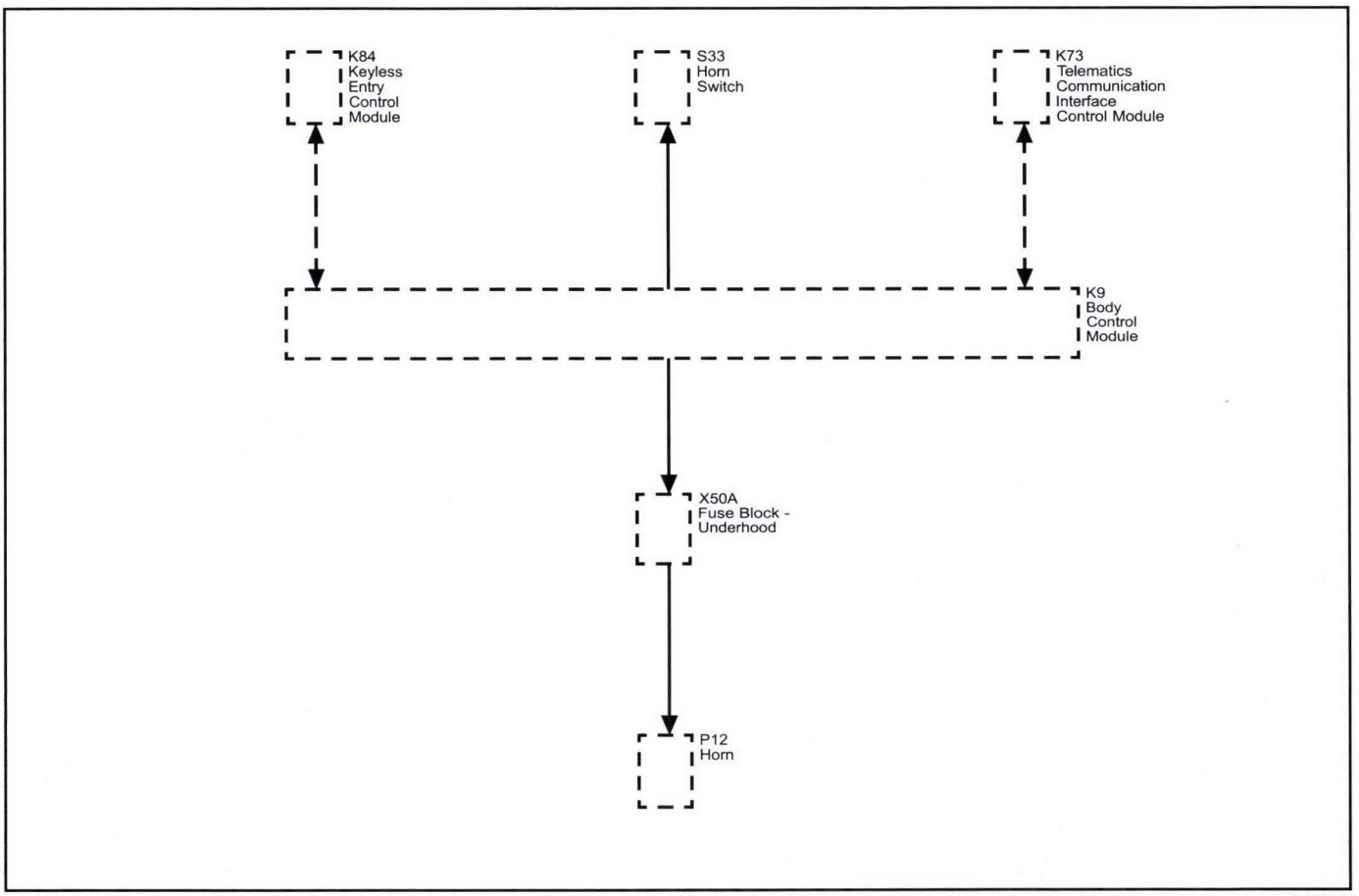
Horns System Description and Operation

System Description

The horn system consists of the following components:

- HORN fuse
- Underhood fuse block (contains PCB horn relay)
- Horn switch
- Horn
- Body control module (BCM)

14 Horns Block Diagram



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System Operation

The vehicle horn system is activated under the following conditions:

- When the horn switch is depressed
- The BCM commands the horns ON under any of the following conditions:
  - When the content theft deterrent system detects a vehicle intrusion—For further information refer to *Theft Systems Description and Operation on page 12-189*.
  - When the panic button is depressed on the remote control door lock transmitter—For further information refer to *Keyless Entry System Description and Operation on page 12-79*.
  - When the keyless entry system is used to lock the vehicle, a horn chirp may sound to notify the driver that the vehicle has been locked. The notification feature may be enabled or disabled through personalization. For further information refer to *Keyless Entry System Description and Operation on page 12-79*.

    When the OnStar® system is used to sound the horns if equipped—For further information, refer to *OnStar Description and Operation on page 8-63*.

Circuit Operation

Battery positive voltage is applied at all times to the horn relay coil and the horn relay switch. Pressing either of the horn switches applies ground to the horn relay control circuit. The BCM may also apply ground to the horn relay control circuit as described above. When the horn relay control circuit is grounded, the horn relay is energized and battery positive voltage is applied to the horns through the horn control circuit. The horns sound as long as ground is applied to the horn relay control circuit.

Lighting

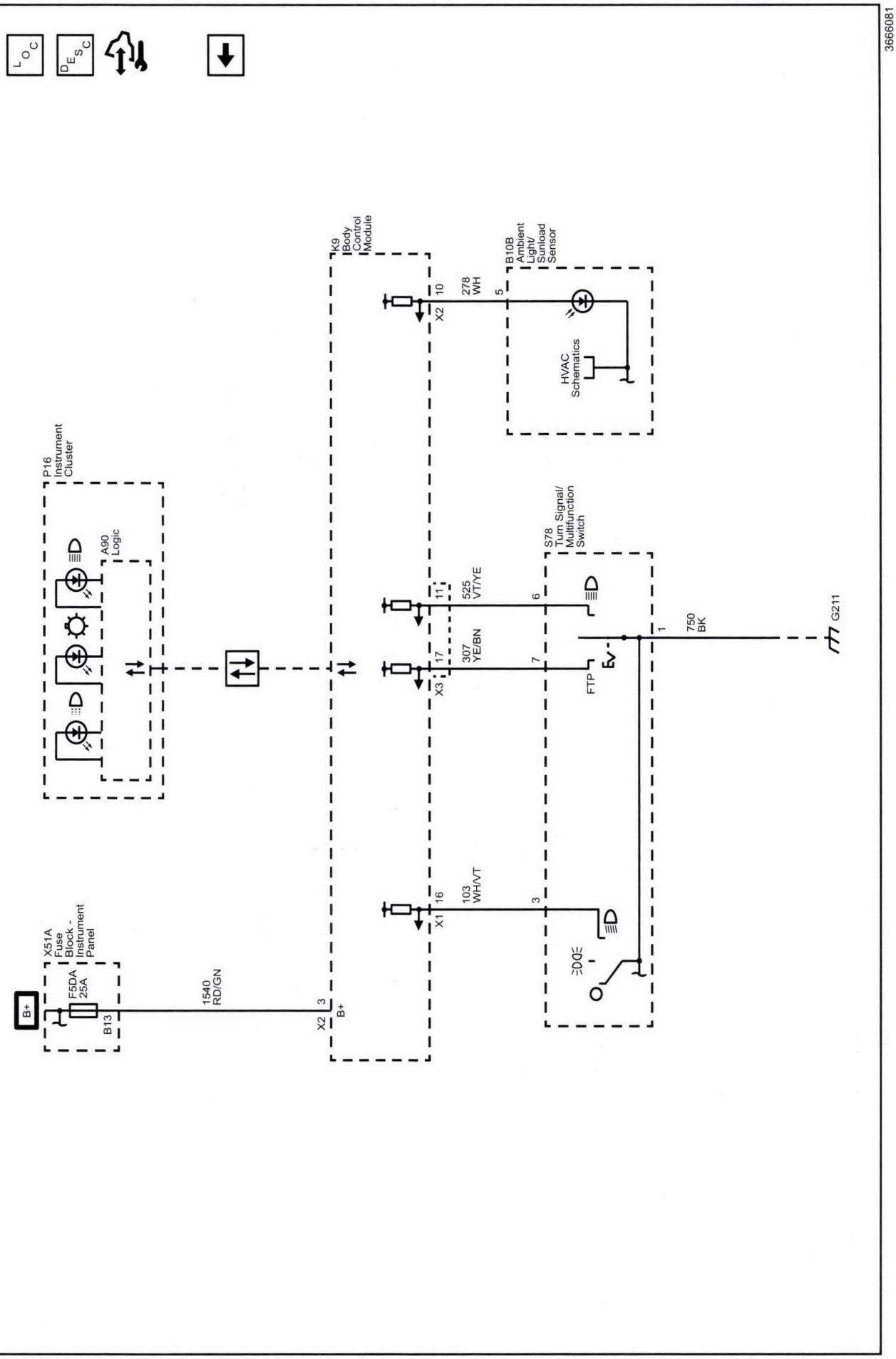
Specifications

Fastener Tightening Specifications

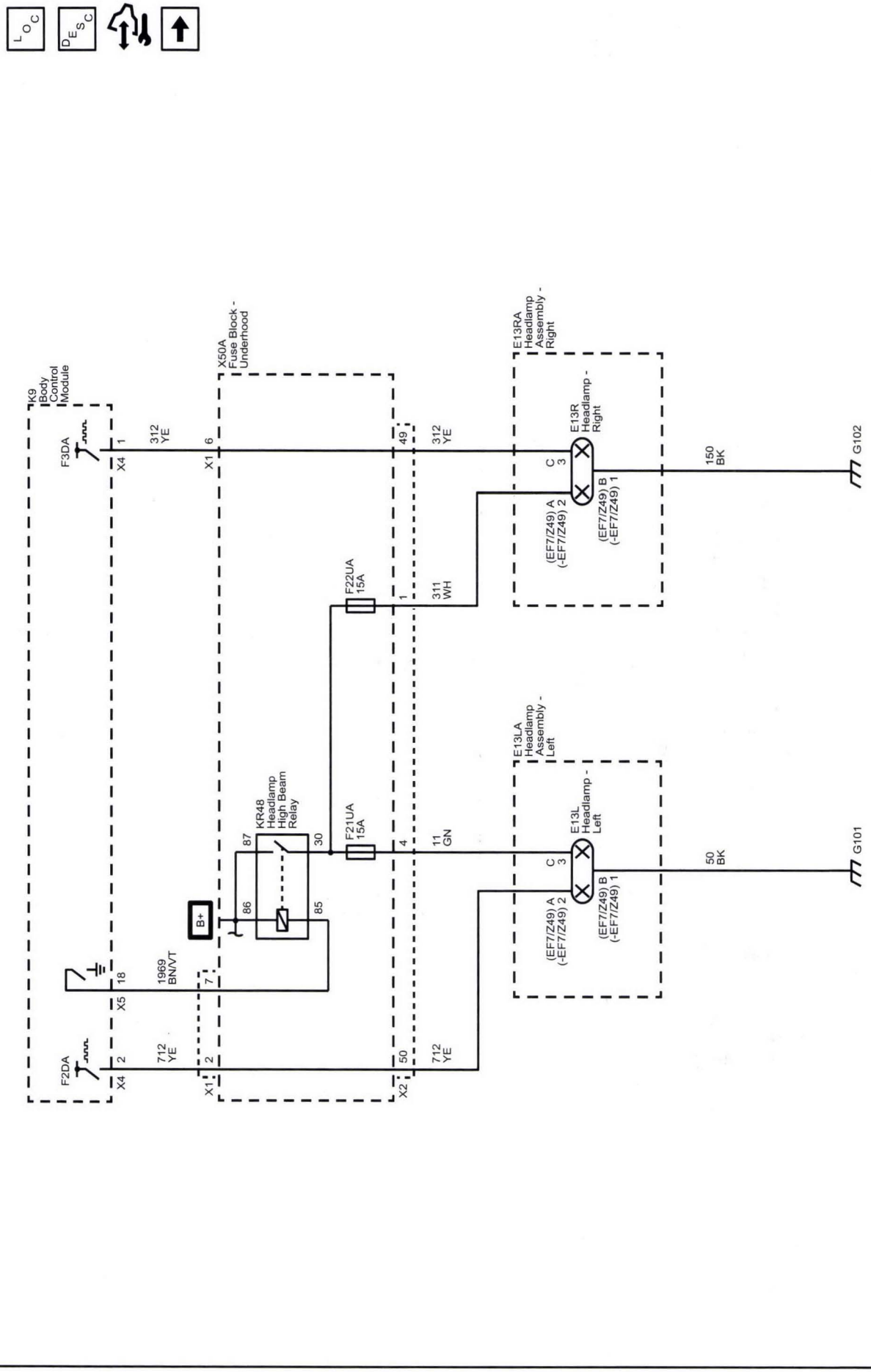
Application	Specification	
	Metric	English
Headlamp Screws	2.5 N•m	22 lb in
High Mount Stop Lamp Bolts	1.0 N•m	9 lb in
Rear End Spoiler Bolts	0.6 N•m	9 lb in
Rear License Plate Lamp Screws	2.0 N•m	18 lb in
Tail Lamp Screws	2.5 N•m	22 lb in

Schematic and Routing Diagrams

Headlights/Daytime Running Lights (DRL) Schematics (Controls and Indicators)



Headlights/Daytime Running Lights (DRL) Schematics (Headlamps)



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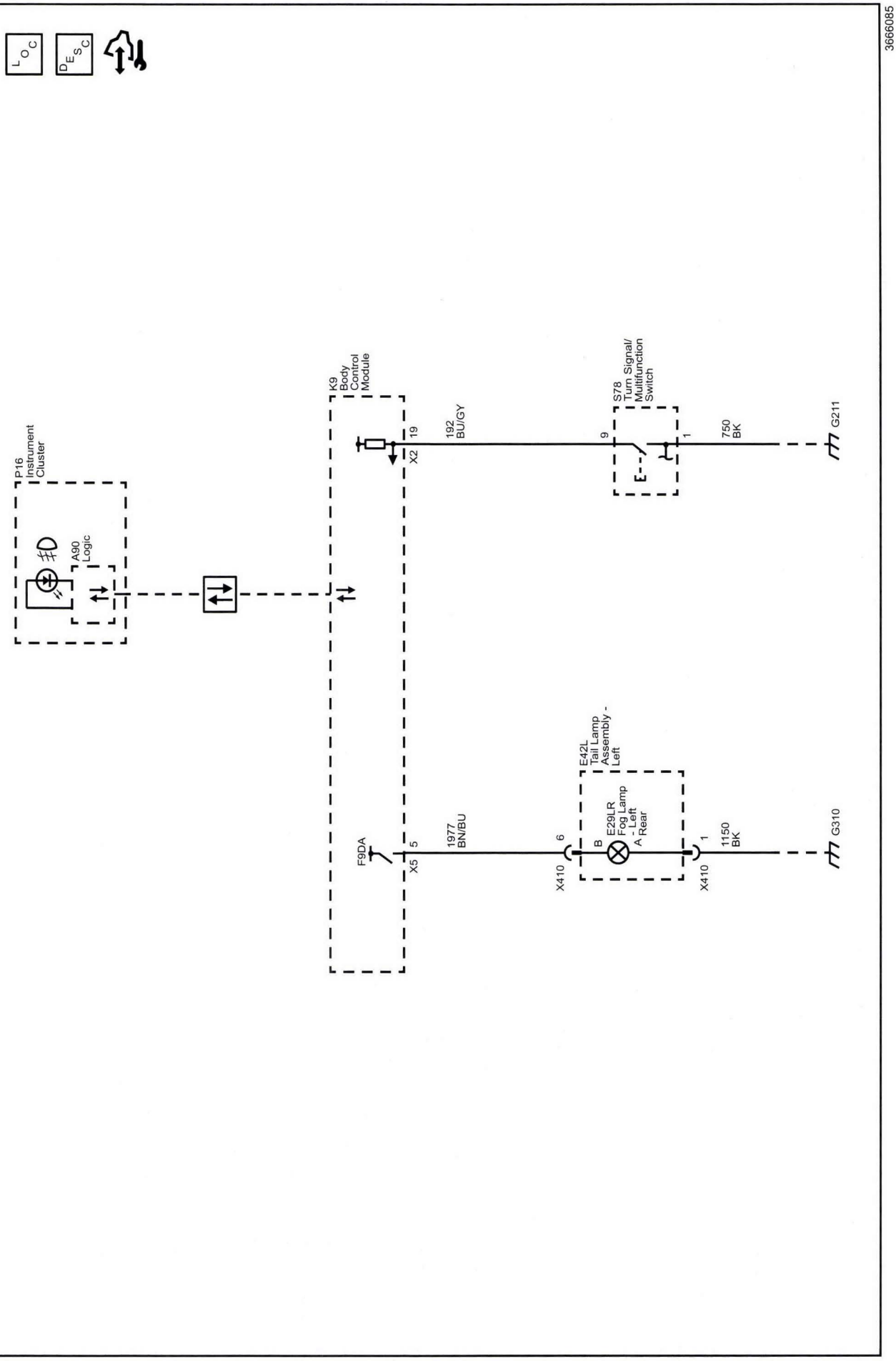
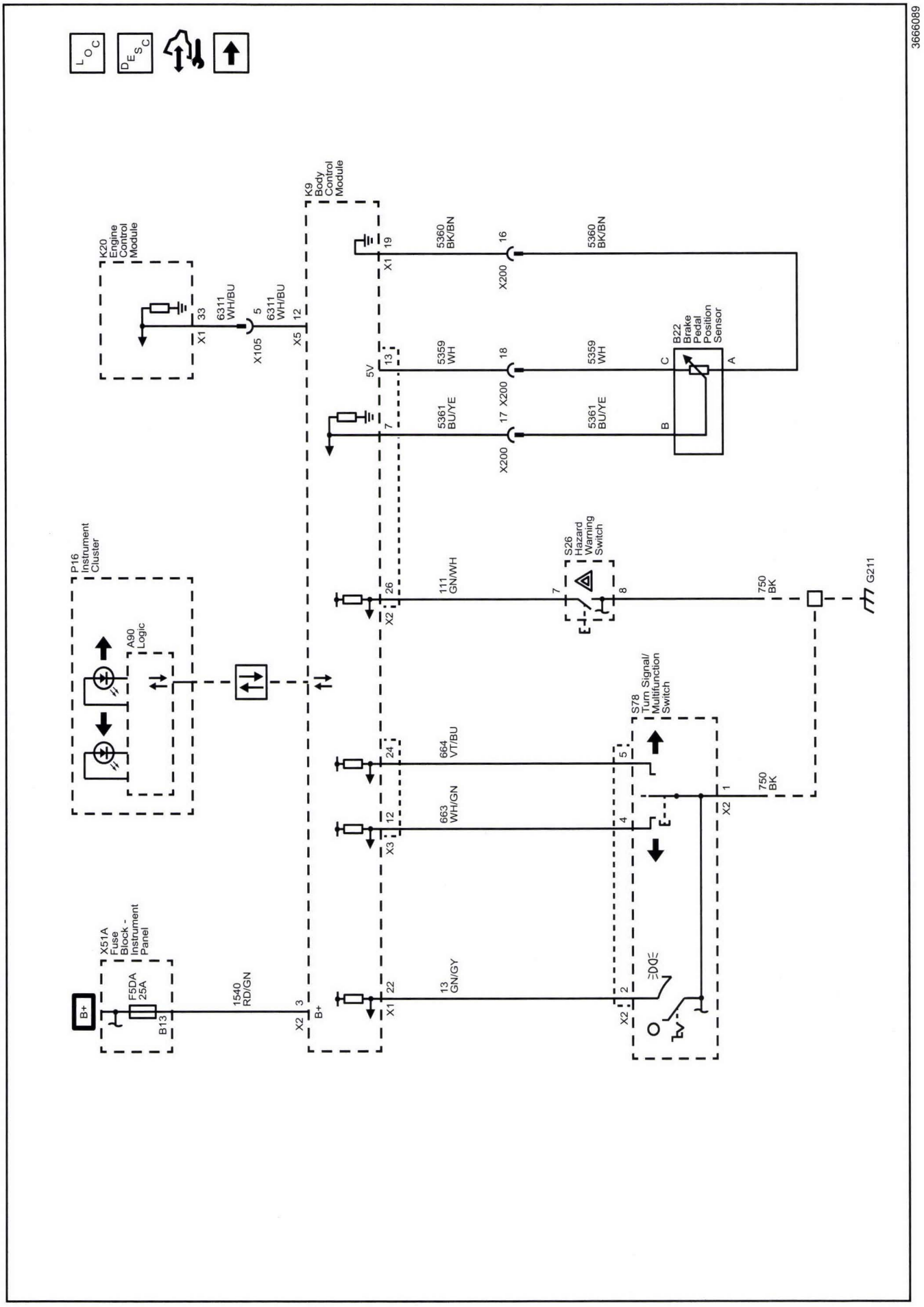
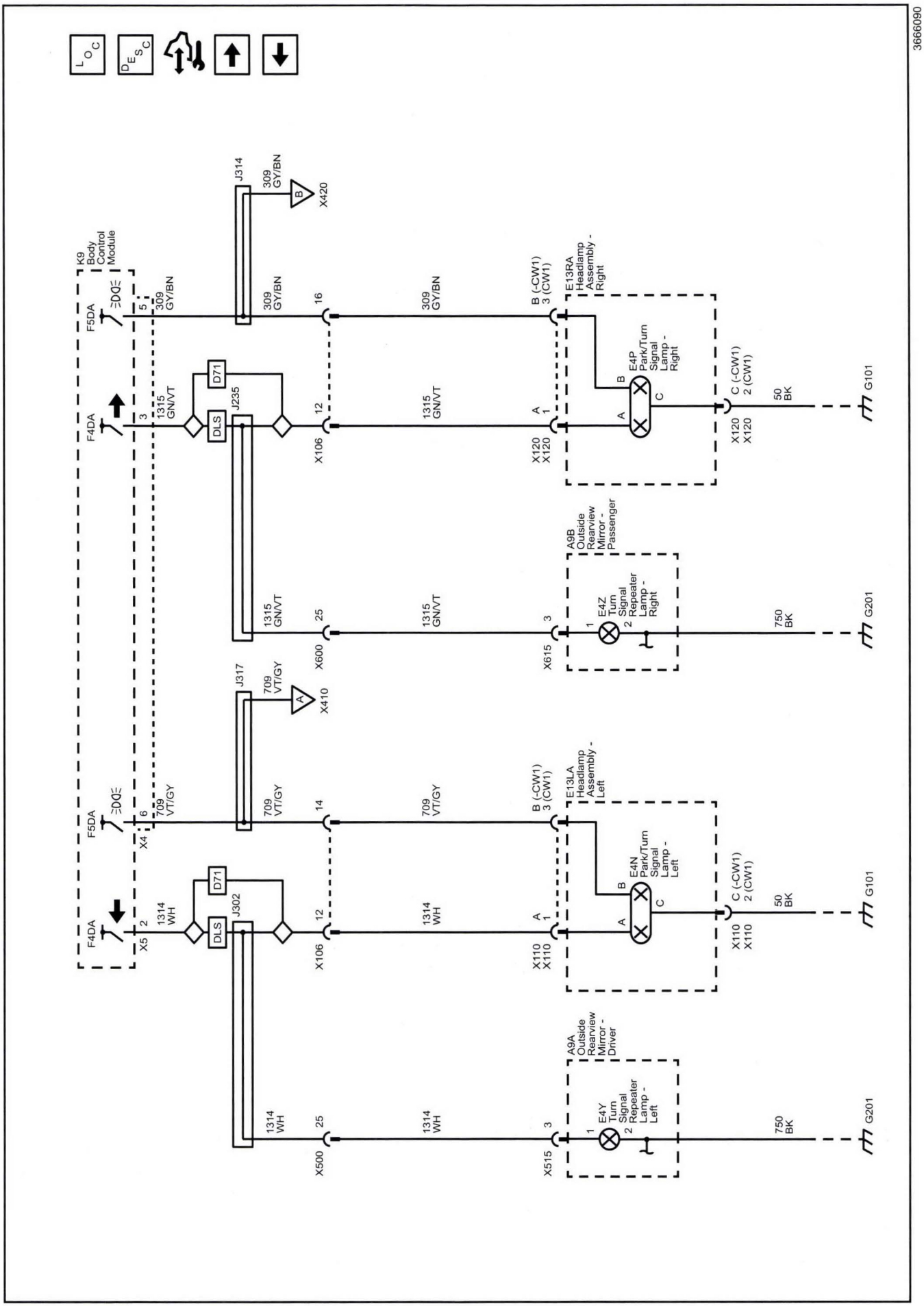
Fog Lights Schematics (Rear Fog Lamps (-T83))



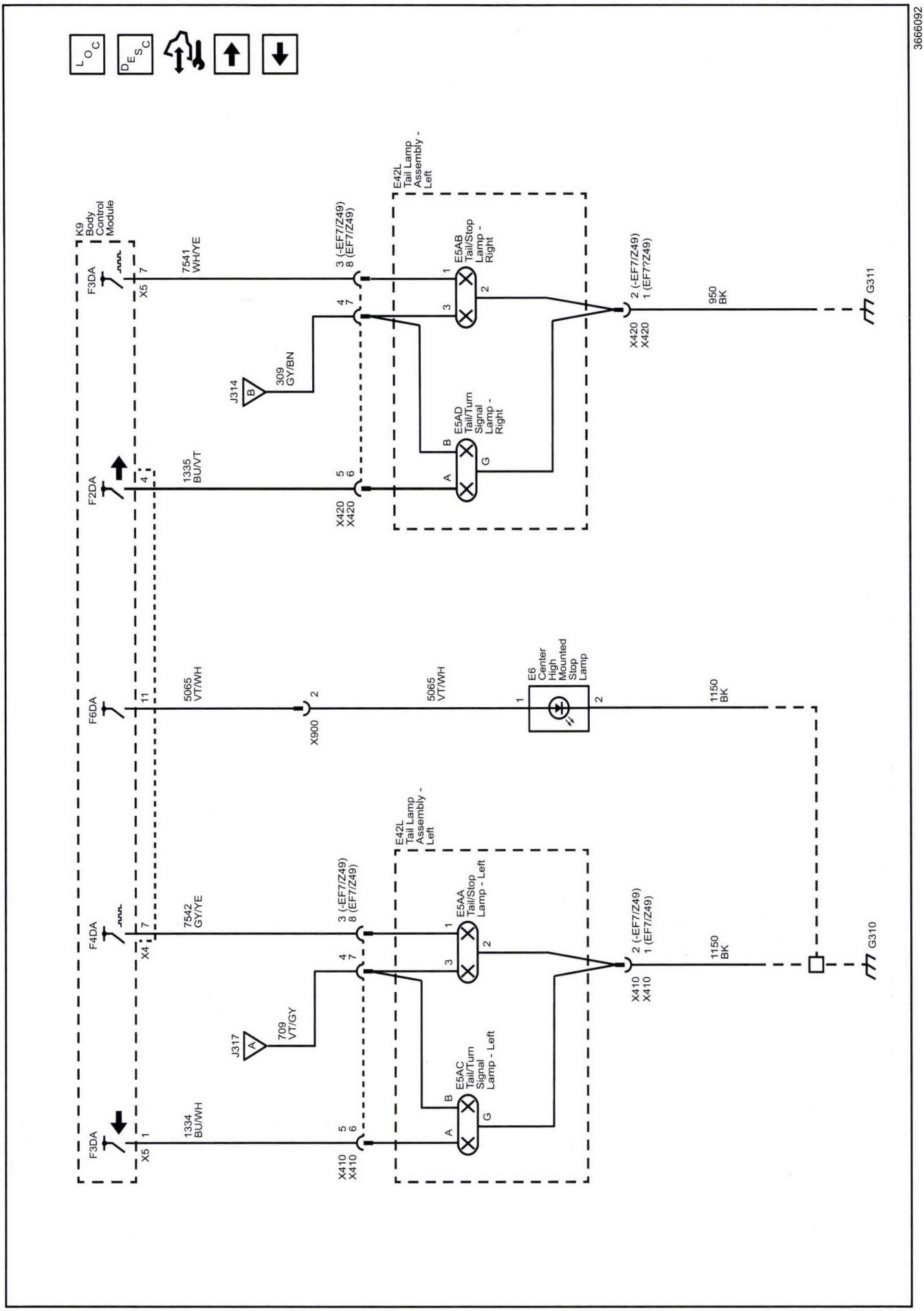
Exterior Lights Schematics (Park, Turn, Hazard, Brake Lamp Controls and Indicators)



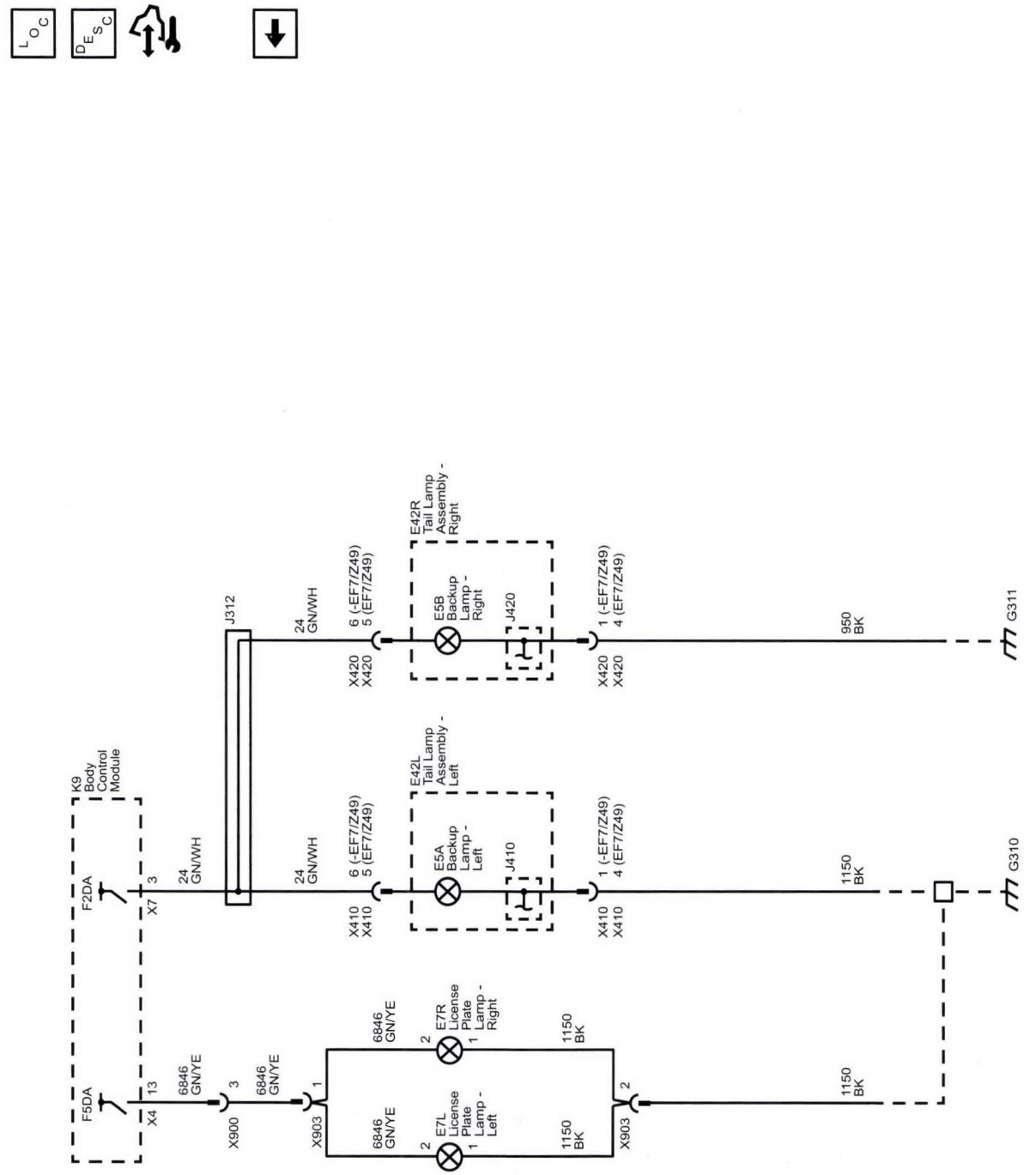
Exterior Lights Schematics (Park Lamps and Front Turn Signal Lamps)

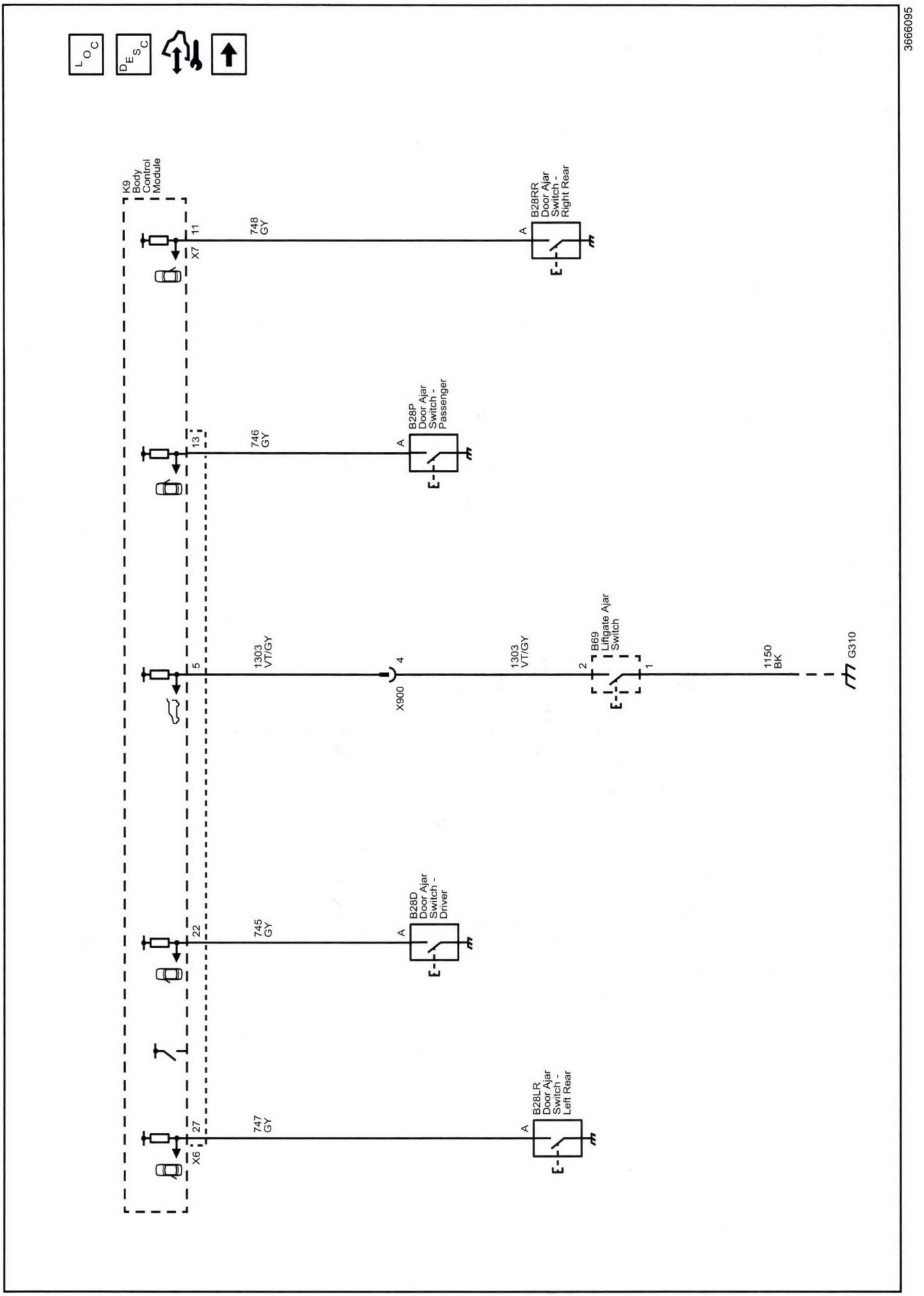


Exterior Lights Schematics (Tail, Stop, and Rear Turn Signal Lamps)

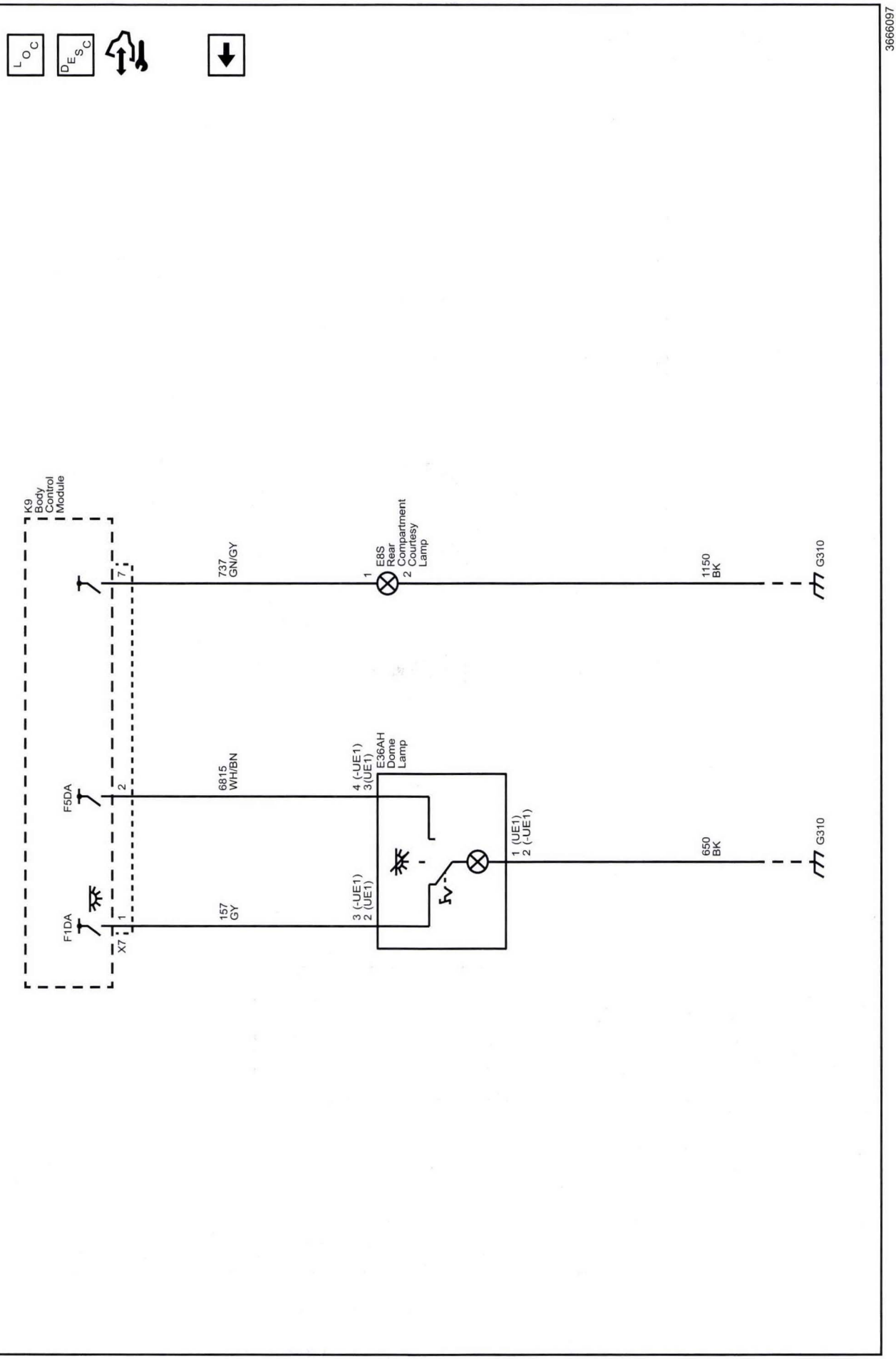


Exterior Lights Schematics (License and Backup Lamps)

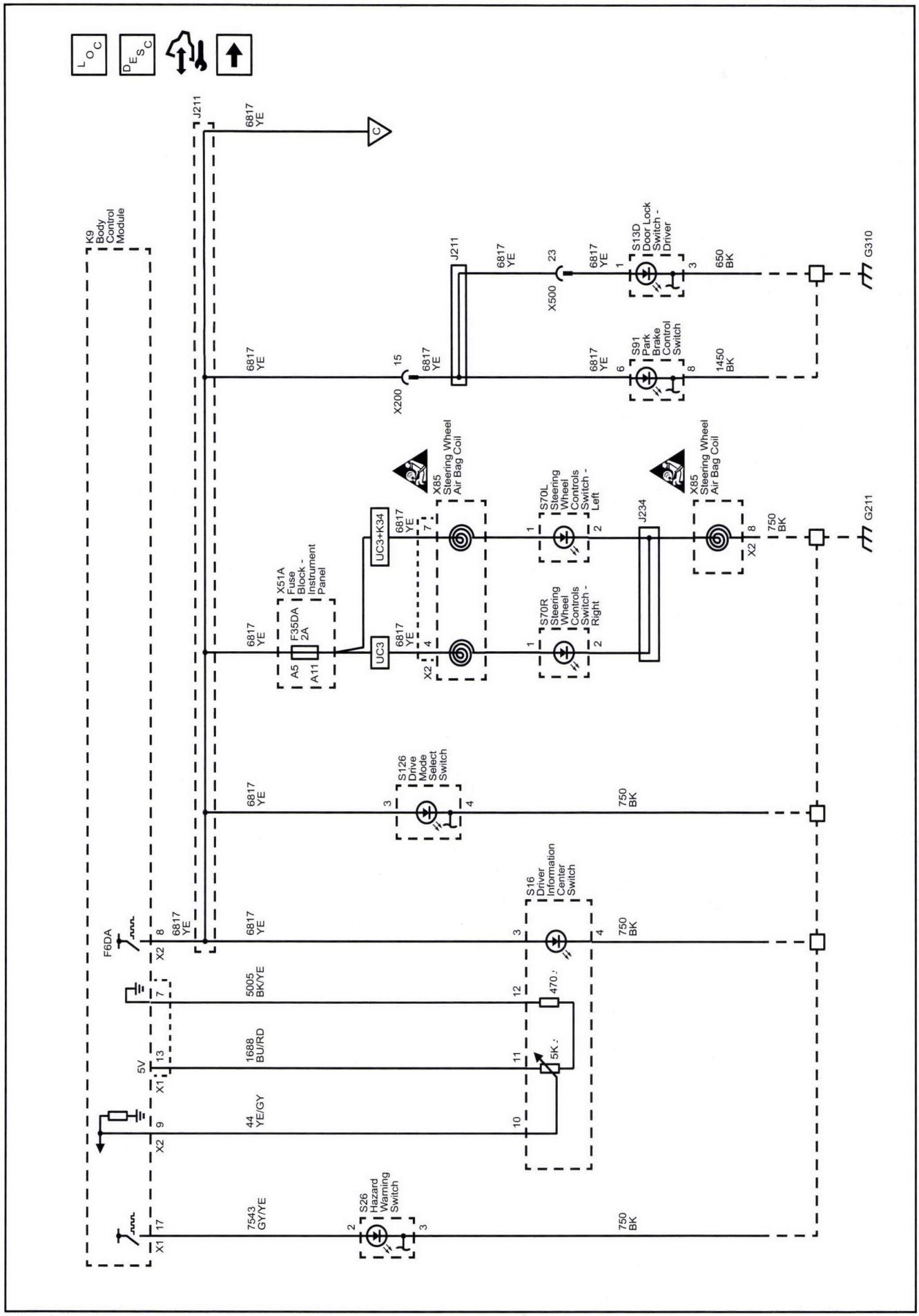



Interior Lights Schematics (Controls)
3666095
K9
Body
Control
Module
X7
11
748
GY
B28RR
Door Ajar
Switch -
Right Rear
A
13
746
GY
B28P
Door Ajar
Switch -
Passenger
A
5
1303
VT/GY
X900
4
1303
VT/GY
2
B69
Liftgate Ajar
Switch
1
1150
BK
G310
22
745
GY
B28D
Door Ajar
Switch -
Driver
A
27
747
GY
B28LR
Door Ajar
Switch -
Left Rear
A
X6

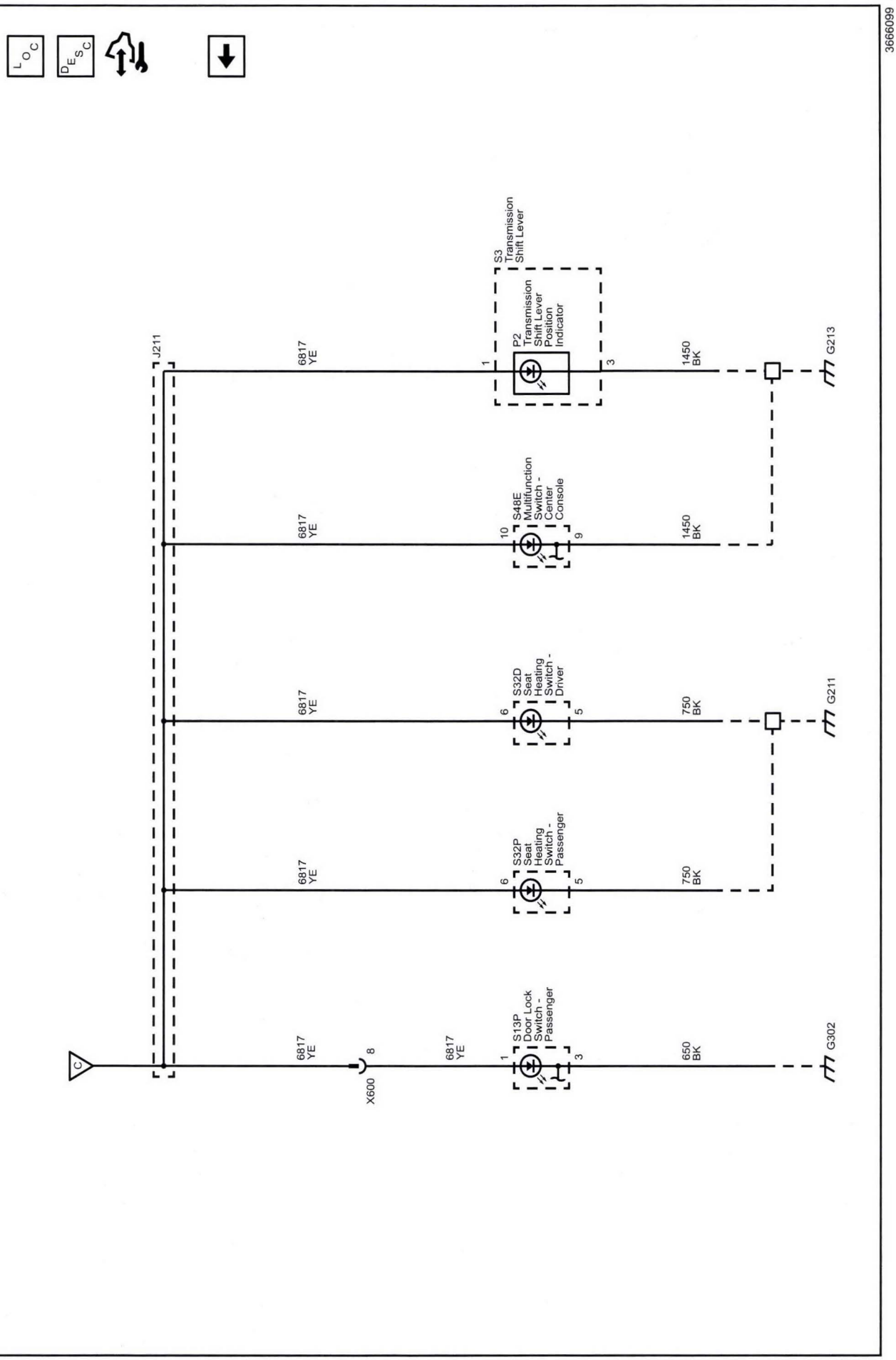
Interior Lights Schematics (Dome Lamps)



Interior Lights Dimming Schematics (Dimmer Switch and I/P)



Interior Lights Dimming Schematics (Doors, Seats and Center Console)



Diagnostic Information and Procedures

DTC B096F

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B096F 01: Power Mode Switch Assembly Backlight Circuit Short to Battery
DTC B096F 02: Power Mode Switch Assembly Backlight Circuit Short to Ground
DTC B096F 04: Power Mode Switch Assembly Backlight Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Mode Switch LED Backlighting Control	B096F 02	B096F 04	B096F 01	—
Ignition Mode Switch Ground	—	1	—	—
1. Interior Backlighting Malfunction				

Circuit/System Description

The instrument panel dimmer switch is used to increase and decrease the brightness of the interior backlighting components. The instrument panel dimmer switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides a low reference, signal, and B+ circuits to the instrument panel dimmer switch. When the instrument panel dimmer switch is placed in the desired position, the dimmed voltage setting is applied from the instrument panel dimmer switch through the instrument panel dimmer switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated (PWM) voltage through the LED dimming control circuits illuminating the interior backlighting to the requested level of brightness.

Conditions for Running the DTC

- Battery voltage must be between 9–16 V.
- Park lamps ON.

Conditions for Setting the DTC

DTC B096F 01

The BCM detects a short to voltage in the ignition mode switch LED backlighting control circuit.

DTC B096F 02

The BCM detects a short to ground in the ignition mode switch LED backlighting control circuit.

DTC B096F 04

The BCM detects an open/high resistance in the ignition mode switch LED backlighting control circuit.

Actions Taken When the DTC Sets

The ignition mode switch LED backlighting will not illuminate.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Interior Lights Dimming Schematics on page 4-76

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Interior Lighting Systems Description and Operation on page 4-200

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S38 Ignition Mode Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 4 and ground.

⇒ **If 5 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

3. Connect a test lamp between the control circuit terminal 2 and ground, vehicle in Service Mode, park lamps ON.
4. Verify the test lamp intensity changes from low to high as the instrument panel dimmer switch is activated from low to high.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON full intensity**

4.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp dims from LOW to HIGH**

5. Test or replace the S38 Ignition Mode Switch.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Ignition and Start Switch Replacement on page 11-957*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC B1395

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B1395 03: Control Module Voltage Reference Output 1 Circuit Low Voltage
DTC B1395 07: Control Module Voltage Reference Output 1 Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F1DA (BCM 1) Fuse B+	B101E 43, B1395 03, B1517 07, C0890 03, U0121 00,	B101E 43, B1395 03, B1517 07, C0890 03, U0121 00,	—	—
Instrument Panel Dimmer Switch B+ Reference	B1395 03, B3600 03,	B3600 03	B1395 07	—
Instrument Panel Dimmer Switch Signal	B1395 03, B3600 03,	B3600 03	B3600 07	—
Instrument Panel Dimmer Switch Low Reference	1	1	1	—
1. Interior Backlighting Malfunction				

Circuit/System Description

The instrument panel dimmer switch is used to increase and decrease the brightness of the interior backlighting components. The instrument panel dimmer switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides B+, low reference, and signal circuits to the instrument panel dimmer switch. When the instrument panel dimmer switch is placed in the desired position, the dimmed voltage setting is applied from the instrument panel dimmer switch through the instrument panel dimmer switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated (PWM) voltage through the LED dimming 1 and dimming 2 control circuits illuminating the interior backlighting to the requested level of brightness.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Park Lamps ON.

Conditions for Setting the DTC

DTC B1395 03

- The BCM detects a short to ground in the instrument panel dimmer switch B+ reference circuit.
- The BCM detects a short to ground in the instrument panel dimmer switch signal circuit.
- The BCM detects a short to ground or an open/high resistance in the F1DA (BCM 1) fuse B+ circuit.

DTC B1395 07

The BCM detects a short to voltage in the instrument panel dimmer switch B+ reference circuit.

Actions Taken When the DTC Sets

The BCM will not dim any interior backlighting. All interior backlighting will default to maximum brightness.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

- *Interior Lights Dimming Schematics on page 4-76*
- *Body Control System Schematics on page 11-14*

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Interior Lighting Systems Description and Operation on page 4-200

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the S16 Driver Information Center Switch, vehicle in Service Mode.
2. Verify a test lamp illuminates between the low reference circuit terminal 12 and B+.

⇒ **If the test lamp does not illuminate**

2.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

2.2. Test for less than 1 V between the low reference circuit terminal 12 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

2.3. Test for less than 2 Ω in the low reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If the test lamp illuminates**

3. Test for B+ between the B+ reference circuit terminal 11 and ground.

⇒ **If less than B+**

3.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.

3.2. Test for infinite resistance between the B+ reference circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

3.3. Test for less than 2 Ω in the B+ reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If B+**

4. Verify a test lamp does not illuminate between the B+ reference circuit terminal 11 and ground.

⇒ **If the test lamp illuminates**

4.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the B+ reference circuit terminal 11 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp does not illuminate**

5. Park lamps ON, verify a test lamp does not illuminate between the signal circuit terminal 10 and ground.

⇒ **If the test lamp illuminates**

5.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.

5.2. Test for less than 1 V between the signal circuit terminal 10 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp does not illuminate**

6. Vehicle in Service Mode, park lamps OFF, test for between 57.4 K ohms and 58 K ohms between the signal circuit terminal 10 and ground.

⇒ **If not between 57.4 K ohms and 58 K ohms**

6.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.

6.2. Test for infinite resistance between the signal circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If between 57.4 K ohms and 58 K ohms**

7. Test or replace the S16 Driver Information Center Switch.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Driver Information Display Switch Replacement on page 8-93*

  Control Module References on page 6-3 for BCM replacement, programming, and setup

DTC B1480

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptor

DTC B1480 02: Battery Rundown Protection Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Dome Lamps Control	B2615 02	2	2	—
Reading Lamps Control	B1480 02	1	1	—
Dome Lamp Ground	—	1, 2	—	—
1. Courtesy Lamps Malfunction 2. Dome Lamps Malfunction				

Circuit/System Description

The body control module (BCM) supplies battery voltage to the reading lamps via the courtesy lamp control circuit. The front reading lamps controlled by an individual switch that is activated by the operator when additional cabin lighting is required. In the event that the reading lamp were to remain illuminated for more than 10 minutes with the vehicle ON/OFF switch in the OFF position and no doors opened, the BCM will deactivate the reading lamp control circuit to prevent total battery discharge.

Conditions for Running the DTC

Battery voltage must be between 9–16 V.

Conditions for Setting the DTC

The BCM detects a short to ground in the reading lamp control circuit.

Actions Taken When the DTC Sets

The BCM will disable the circuit and the reading lamp will be inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

- *Interior Lights Schematics on page 4-74*
- *Body Control System Schematics on page 11-14*

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Interior Lighting Systems Description and Operation on page 4-200

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connectors at the E36AH Dome Lamp.
2. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
   - E36AH Dome Lamp – terminal 3 with UE1
   - E36AH Dome Lamp – terminal 4 without UE1

3. Verify the test lamp turns ON and OFF when commanding the Inadvertent Load ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

3.1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.

3.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

3.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

3.1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.

3.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

4. Test or replace the E36AH Dome Lamp.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Center Courtesy Lamp Bulb Replacement on page 4-177*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC B2540

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B2540 02: Rear Fog Lamps Control Circuit Short to Ground
DTC B2540 04: Rear Fog Lamps Control Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Rear Fog Lamp Switch Signal	B3588 00	1	1	—
Rear Fog Lamp Control	B2540 02	B2540 04	1	—
Rear Fog Lamp Ground	—	1	—	—
Turn Signal/Multifunction Switch Ground	—	1	—	—
1. Rear Fog Lamp Malfunction				

Circuit/System Description

The rear fog lamp switch signal circuit is grounded momentarily by pressing the rear fog lamp switch. The body control module (BCM) responds to the rear fog lamp request by applying voltage to the rear fog lamp control circuit which illuminates the rear fog lamp.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Rear fog lamp ON.

Conditions for Setting the DTC

DTC B2540 02

The BCM detects a short to ground in the rear fog lamp control circuit.

DTC B2540 04

The BCM detects an open/high resistance in the rear fog lamp control circuit.

Actions Taken When the DTC Sets

The rear fog lamp will not operate when the park lamps are ON and the rear fog lamp switch is active.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Fog Lights Schematics on page 4-69

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the appropriate E29 Fog Lamp – Rear at the appropriate E42 Tail Lamp Assembly.
2. Test for less than 5 Ω between the ground circuit terminal A and ground.

⇒ **If 5 Ω or greater**

2.1. Vehicle OFF.
2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

3. Connect a test lamp between the control circuit terminal B and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the Rear Fog Lamp ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

4.1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

5. Test or replace the appropriate E29 Fog Lamp – Rear.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Tail Lamp Replacement on page 4-192*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC B2545

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B2545 01: Backup Lamps Circuit Short to Battery
DTC B2545 02: Backup Lamps Circuit Short to Ground
DTC B2545 04: Backup Lamps Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F6DA (BCM 6) Fuse B+	B2545 01, B2545 04, B2615 02	B2545 01, B2545 04, B2615 02	—	—
Backup Lamp Switch Signal (Manual Transmission)	P0812	P0812	1	—
Backup Lamps Control	B2545 02	B2545 01, B2545 04	B2545 01	—
Backup Lamp Switch Ground (Manual Transmission)	—	P0812	—	—
Backup Lamp Ground – Left	—	1	—	—
Backup Lamp Ground – Right	—	1	—	—
1. Backup Lamps Malfunction				

Circuit/System Description

With the vehicle ON and the transmission in the reverse position, the transmission control module (TCM) sends a serial data message to the body control module (BCM). The message indicates that the gear selector is in the reverse position. The BCM applies battery voltage to the backup lamps control circuit illuminating the backup lamps. Once the driver moves the gear selector out of the reverse position, a message is sent by the TCM via serial data requesting the BCM to remove battery voltage from the backup lamps control circuit. The engine must be running for the backup lamps to operate.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Vehicle in Service Mode.
- Transmission placed in REVERSE gear.

Conditions for Setting the DTC

DTC B2545 01 and DTC B2545 04

- The BCM detects an open/high resistance in the backup lamps control circuit.
- The BCM detects a short to ground or an open/high resistance in the F6DA (BCM 6) fuse B+ circuit.

DTC B2545 02

The BCM detects a short to ground in the backup lamps control circuit.

Actions Taken When the DTC Sets

DTC B2545 02 and B2545 04

The backup lamps will not operate.

DTC B2545 01

The backup lamps are always ON.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Diagnostic Aids

When testing at the backup lamp bulb socket, make sure all measurements and test lamp connections are in the correct terminal location and do not come in contact with each other during testing.

Reference Information

Schematic Reference

- *Exterior Lights Schematics on page 4-70*
- *Body Control System Schematics on page 11-14*

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

2.1. Vehicle OFF.

2.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If the test lamp illuminates**

3. Vehicle OFF, connect the X5 harness connector at the K9 Body Control Module.
4. Vehicle OFF, exterior lamps OFF, remove the appropriate E5 Backup Lamp bulb at the appropriate E42 Tail Lamp assembly. It may take up to 2 minutes for all vehicle systems to power down.
5. Test for less than 5 Ω between the ground circuit at the socket terminal and ground.

⇒ **If 5 Ω or greater**

5.1. Vehicle OFF.

5.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

6. Connect a test lamp between the control circuit at the socket terminal and ground, vehicle in Service Mode.
7. Verify the test lamp turns ON and OFF when commanding the Backup Lamps ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

7.1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.

7.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

7.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

7.1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.

7.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

8. Test or replace the appropriate E5 Backup Lamp.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Stop and Tail Lamp Bulb Replacement (North America) on page 4-196* or *Stop and Tail Lamp Bulb Replacement (Europe, Korea) on page 4-197*
- *Tail and Turn Signal Lamp Bulb Replacement (North America) on page 4-193* or *Tail and Turn Signal Lamp Bulb Replacement (Europe, Korea) on page 4-194*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC B2570

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptor

DTC B2570 02: Trunk Lamp Control Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Rear Compartment Courtesy Lamp Control	B2570 02	1	1	—
Rear Compartment Courtesy Lamp Ground	—	1	—	—
1. Rear Compartment Lamp Malfunction				

Circuit/System Description

The body control module (BCM) applies battery voltage to the rear compartment courtesy lamp through the rear compartment lamp control circuit. When the BCM receives a rear compartment lid open input from the rear compartment lid latch, the BCM applies battery voltage to the rear compartment lamp control circuit illuminating the rear compartment courtesy lamp. In the event that the rear compartment lamp were to remain illuminated for more than 10 minutes with the ignition switch in the OFF position and no doors opened, the BCM will deactivate the rear compartment lamp control circuit to prevent total battery discharge.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Rear compartment OPEN.

Conditions for Setting the DTC

The BCM detects a short to ground on the rear compartment courtesy lamp control circuit.

Actions Taken When the DTC Sets

The rear compartment lamp is inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Interior Lights Schematics on page 4-74

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Interior Lighting Systems Description and Operation on page 4-200

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E8S Rear Compartment Courtesy Lamp. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 2 and ground.

⇒ **If 5 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

3. Connect a test lamp between the control circuit terminal 1 and ground, vehicle in Service Mode.

4. Verify the test lamp turns ON and OFF when commanding the Cargo Lamp ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

4.1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

5. Test or replace the E8S Rear Compartment Courtesy Lamp.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Rear Compartment Courtesy Lamp Replacement on page 4-198*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC B2575 or B2699

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B2575 01: Headlamps Control Circuit Short to Battery
DTC B2575 02: Headlamps Control Circuit Short to Ground
DTC B2575 04: Headlamps Control Circuit Open
DTC B2699 01: Right Headlamp Control Circuit Short to Battery
DTC B2699 02: Right Headlamp Control Circuit Short to Ground
DTC B2699 04: Right Headlamp Control Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F3DA (BCM 3) Fuse B+	B2699 01, B2699 04	B2699 01, B2699 04	—	—
F4DA (BCM 4) Fuse B+	B2575 01, B2575 04	B2575 01, B2575 04	—	—
Low Beam Headlamp Control – Left	B2575 02	B2575 01, B2575 04	B2575 04	—
Low Beam Headlamp Control – Right	B2699 02	B2699 01, B2699 04	B2699 04	—
Headlamp Ground – Left	—	1	—	—
Headlamp Ground – Right	—	1	—	—
1. Headlamps Malfunction				

Circuit/System Description

With the headlamp switch in the ON position, the headlamp switch headlamp ON signal circuit is grounded through the headlamp switch. The body control module (BCM) responds by applying battery positive voltage to the left and right low beam headlamp control circuits illuminating the low beam headlamps.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Low beam headlamps ON.

Conditions for Setting the DTC

DTC B2575 01 and B2575 04

- The BCM detects a short to voltage or an open/high resistance in the left low beam headlamp control circuit.
- The BCM detects a short to ground or an open/high resistance in the F4DA (BCM 4) fuse B+ circuit.

DTC B2575 02

The BCM detects a short to ground in the left low beam headlamp control circuit.

DTC B2699 01 and B2699 04

- The BCM detects a short to voltage or an open/high resistance in the right low beam headlamp control circuit.
- The BCM detects a short to ground or an open/high resistance in the F3DA (BCM 3) fuse B+ circuit.

DTC B2699 02

The BCM detects a short to ground in the right low beam headlamp control circuit.

Actions Taken When the DTC Sets

- When DTC B2575 sets, the left low beam headlamp will be inoperative.
- When DTC B2699 sets, the right low beam headlamp will be inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

- *Headlights/Daytime Running Lights (DRL) Schematics on page 4-67*
- *Body Control System Schematics on page 11-14*

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

DTC B2575

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

2.1. Vehicle OFF.

2.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If the test lamp illuminates**

3. Vehicle OFF, connect the X1 harness connector at the K9 Body Control Module.
4. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E13L Headlamp - Left.
5. Test for less than 5 Ω between the appropriate ground circuit terminal listed below and ground.
   - E13L Headlamp - Left – terminal 1 without EF7/Z49
   - E13L Headlamp - Left – terminal B with EF7/Z49

⇒ **If 5 Ω or greater**

5.1. Vehicle OFF.

5.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

6. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
   - E13L Headlamp - Left – terminal 2 without EF7/Z49
   - E13L Headlamp - Left – terminal A with EF7/Z49
7. Verify the test lamp turns ON and OFF when commanding the Left Low Beam/Daytime Running Lamp ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

7.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.

7.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

7.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

7.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.

7.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

8. Test or replace the E13L Headlamp bulb – Left.

DTC B2699

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

2.1. Vehicle OFF.

2.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If the test lamp illuminates**

3. Vehicle OFF, connect the X1 harness connector at the K9 Body Control Module.
4. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E13R Headlamp - Right.
5. Test for less than 5 Ω between the appropriate ground circuit terminal listed below and ground.
   - E13R Headlamp - Right – terminal 1 without EF7/Z49
   - E13R Headlamp - Right – terminal B with EF7/Z49

⇒ **If 5 Ω or greater**

5.1. Vehicle OFF.

5.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

6. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
   - E13R Headlamp - Right – terminal 3 without EF7/Z49
   - E13R Headlamp - Right – terminal C with EF7/Z49
7. Verify the test lamp turns ON and OFF when commanding the Right Low Beam/Daytime Running Lamp ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

7.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.

7.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

7.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

7.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.

7.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

8. Test or replace the E13R Headlamp bulb – Right.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Headlamp Bulb Replacement (North America) on page 4-179* or *Headlamp Bulb Replacement (Europe, Korea) on page 4-180*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC B257A

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptor

DTC B257A 00: Headlamp Switch Input Signals Correlation Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp Switch Park Lamps ON Signal	2	B257A 00	2	—
Headlamp Switch Headlamps ON Signal	B257A 00	1	1	—
Turn Signal/Multifunction Switch Ground	—	1	—	—
1. Headlamps Malfunction 2. Park, License, and/or Tail Lamps Malfunction				

Circuit/System Description

For headlamp operation, the body control module (BCM) monitors two signal circuits from the headlamp switch. With the headlamp switch in the PARK LAMPS position, the headlamp switch park lamps ON signal circuit is grounded, indicating that the park lamps have been requested. When the headlamp switch is in the HEADLAMP position, both the headlamp switch park lamps ON signal circuit and the headlamp switch headlamps ON signal circuit are grounded. The BCM responds by commanding the park lamps and headlamps ON.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

- The BCM detects an open/high resistance in the headlamp switch park lamps ON signal circuit.
- The BCM detects a short to ground in the headlamp switch headlamps ON signal circuit.

Actions Taken When the DTC Sets

- When DTC B257A 00 is present on the headlamp switch headlamps ON signal circuit, the low beam headlamps are always ON. The BCM disregards all headlamp switch inputs.
- When DTC B257A 00 is present on the headlamp switch park lamps ON signal circuit, the park lamps and low beam headlamps are inoperative in the PARK and HEAD positions.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics on page 4-67

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/Multifunction Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 15 Ω between the ground circuit terminal 1 and ground.

⇒ **If 15 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 15 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Park Lamps Switch parameter is Inactive.

⇒ **If not Inactive**

4.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit terminal 2 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 body control module.

⇓ **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 1.
6. Verify the scan tool Park Lamps Switch parameter is Active.

⇒ **If not Active**

6.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit terminal 2 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

7. Verify the scan tool Headlamps On Switch parameter is Inactive.

⇒ **If not Inactive**

7.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.

7.2. Test for infinite resistance between the signal circuit terminal 3 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

8. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ground circuit terminal 1.
9. Verify the scan tool Headlamps On Switch parameter is Active.

⇒ **If not Active**

9.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

9.2. Test for less than 1 V between the signal circuit terminal 3 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

9.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

10. Test or replace the S78 Turn Signal/Multifunction Switch.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Turn Signal Switch Replacement on page 14-31*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC B2580

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B2580 01: Headlamp High Beam Control Circuit Short to Battery
DTC B2580 02: Headlamp High Beam Control Circuit Short to Ground
DTC B2580 04: Headlamp High Beam Control Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F3DA (BCM 3) Fuse B+	B2699 01, B2699 04	B2699 01, B2699 04	—	—
F4DA (BCM 4) Fuse B+	B2575 01, B2575 04	B2575 01, B2575 04	—	—
Headlamp High Beam Relay Control	B2580 02	B2580 04	B2580 01	—
High Beam Headlamp Control – Left	1	1	1	—
High Beam Headlamp Control – Right	1	1	1	—
Headlamp Ground – Left	—	B2575 01, B2575 04	—	—
Headlamp Ground – Right	—	B2699 01, B2699 04	—	—
1. Headlamps Malfunction				

Circuit/System Description

The high beam and flash to pass functions are contained within the turn signal/multifunction switch. The BCM provides the turn signal/multifunction switch with two signal circuits, the high beam signal circuit and the flash to pass signal circuit. When the low beam headlamps are ON and the turn signal/multifunction switch is placed in the high beam position, ground is applied to the BCM through the high beam signal circuit. The BCM responds to the high beam request by applying ground to the high beam relay control circuit which energizes the high beam relay. With the high beam relay energized, the switch contacts close allowing battery voltage to flow through the high beam fuses to the high beam control circuits illuminating the high beam headlamps.

Conditions for Running the DTC

- Battery voltage must be between 9–16 V.
- High beam headlamps ON.

Conditions for Setting the DTC

DTC B2580 01

The BCM detects a short to voltage in the headlamp high beam relay control circuit.

DTC B2580 02

The BCM detects a short to ground in the headlamp high beam relay control circuit.

DTC B2580 04

The BCM detects an open in the headlamp high beam relay control circuit.

Actions Taken When the DTC Sets

The high beam headlamps and flash to pass will not operate.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics on page 4-67

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, remove the KR48 Headlamp High Beam Relay.
2. Connect a test lamp between the control circuit terminal 86 and B+, vehicle in Service Mode.
3. Verify the test lamp turns ON and OFF when commanding the High Beams ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

3.1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.

3.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

3.3. Vehicle OFF.

3.4. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

3.1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module.

3.2. Test for infinite resistance between the control circuit terminal and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

4. Test or replace the KR48 Headlamp High Beam Relay.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Relay Replacement (Within an Electrical Center) on page 11-953* or *Relay Replacement (Attached to Wire Harness) on page 11-953*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC B2585 or B3867

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B2585 01: Left Park Lamps Control Circuit Short to Battery
DTC B2585 02: Left Park Lamps Control Circuit Short to Ground
DTC B2585 04: Left Park Lamps Control Circuit Open
DTC B3867 01: Right Park Lamps Control Circuit Short to Battery
DTC B3867 02: Right Park Lamps Control Circuit Short to Ground
DTC B3867 04: Right Park Lamps Control Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F5DA (BCM 5) Fuse B+	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	—	—
Headlamp Switch Park Lamps ON Signal	2	B257A 00	2	—
Front Park and Rear Tail Lamp Control - Left	B2585 02	B2585 01, B2585 04	B2585 01, B2585 04	—
Front Park and Rear Tail Lamp Control - Right	B3867 02	B3867 01, B3867 04	B3867 01, B3867 04	—
Turn Signal/Multifunction Switch Ground	—	2	—	—
Park Lamp Ground - Left Front	—	1	—	—
Park Lamp Ground - Right Front	—	1	—	—
Rear Tail/Stop Lamps Ground - Left	—	1	—	—
Rear Tail/Stop Lamps Ground - Right	—	1	—	—
1. Park, License, and/or Tail Lamps Malfunction 2. Park Lamp Switch Malfunction				

Circuit/System Description

When the headlamp switch is placed in the HEAD or PARK position, ground is applied to the park lamp switch ON signal circuit to the body control module (BCM). The BCM responds by applying voltage to the park lamps, tail lamps, and license lamps control circuits illuminating the park, tail, and license lamps.

Conditions for Running the DTC

- Battery voltage must be between 9–16 V.
- Park lamps ON.

Conditions for Setting the DTC

DTC B2585 01 and B2585 04

The BCM detects a short to voltage or an open/high resistance in the left park lamps control circuit.

DTC B2585 02

The BCM detects a short to ground in the left park lamps control circuit.

DTC B3867 01 and B3867 04

- The BCM detects a short to voltage or an open/high resistance in the right park lamps control circuit.
- The BCM detects a short to ground or an open/high resistance in the F5DA (BCM 5) fuse B+ circuit.

DTC B3867 02

The BCM detects a short to ground in the right park lamps control circuit.

Actions Taken When the DTC Sets

DTC B2585 01

The left park lamps are always ON.

DTC B2585 02 and B2585 04

The left park lamps are always OFF.

DTC B3867 01

The right park lamps are always ON.

DTC B3867 02 and B3867 04

The right park lamps are always OFF.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Diagnostic Aids

When testing at the park lamp bulb sockets, make sure all measurements and test lamp connections are in the correct terminal location and do not come in contact with each other during testing.

Reference Information

Schematic Reference

- *Exterior Lights Schematics on page 4-70*
- *Body Control System Schematics on page 11-14*

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

DTC B2585

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

2.1. Vehicle OFF.

2.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If the test lamp illuminates**

3. Vehicle OFF, connect the X1 harness connector at the K9 Body Control Module.
4. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the appropriate left front park lamp or left rear tail lamp. It may take up to 2 min for all vehicle systems to power down.
5. Test for less than 5 Ω between the appropriate ground circuit terminal listed below and ground.
   - E4N Park/Turn Signal Lamp – Left terminal C
   - E5AA Tail/Stop Lamp – Left terminal 2
   - E5AC Tail/Turn Signal Lamp – Left terminal G

⇒ **If 5 Ω or greater**

5.1. Vehicle OFF.

5.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

6. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
   - E4N Park/Turn Signal Lamp – Left terminal B
   - E5AA Tail/Stop Lamp – Left terminal 3
   - E5AC Tail/Turn Signal Lamp – Left terminal B

7. Verify the test lamp turns ON and OFF when commanding the Left Park Lamps ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

7.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.

7.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

7.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

7.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.

7.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

8. Test or replace the appropriate left park/tail lamp.

DTC B3867

1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

2.1. Vehicle OFF.

2.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If the test lamp illuminates**

3. Vehicle OFF, connect the X2 harness connector at the K9 Body Control Module.
4. Disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
5. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

5.1. Vehicle OFF.

5.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

5.1. Vehicle OFF.

5.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If the test lamp illuminates**

6. Vehicle OFF, connect the X1 harness connector at the K9 Body Control Module.
7. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the appropriate right front park lamp or right rear side marker lamp. It may take up to 2 min for all vehicle systems to power down.
8. Test for less than 5 Ω between the appropriate ground circuit terminal listed below and ground.
   - E4P Park/Turn Signal Lamp – Right terminal C
   - E5AB Tail/Stop Lamp – Right terminal 2
   - E5AD Tail/Turn Signal Lamp – Right terminal G

⇒ **If 5 Ω or greater**

8.1. Vehicle OFF.

8.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

9. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
   - E4P Park/Turn Signal Lamp – Right terminal B
   - E5AB Tail/Stop Lamp – Right terminal 3
   - E5AD Tail/Turn Signal Lamp – Right terminal B

10. Verify the test lamp turns ON and OFF when commanding the Right Park Lamps ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

10.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.

10.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

10.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

10.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.

10.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

11. Test or replace the appropriate right park/tail lamp.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Tail Lamp Replacement on page 4-192*
- *Front Turn Signal Lamp Bulb Replacement (North America) on page 4-187* or *Front Turn Signal Lamp Bulb Replacement (Europe, Korea) on page 4-188*
- *Tail and Turn Signal Lamp Bulb Replacement (North America) on page 4-193* or *Tail and Turn Signal Lamp Bulb Replacement (Europe, Korea) on page 4-194*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC B2610

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B2610 01: Passenger Compartment Dimming 1 Circuit Short to Battery
DTC B2610 02: Passenger Compartment Dimming 1 Circuit Short to Ground
DTC B2610 04: Passenger Compartment Dimming 1 Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
LED Backlight Dimming Control Terminal 8 X2	B2610 02	B2610 04, 1	B2610 01, 1	—
Door Lock Switch – Driver Ground	—	1	—	—
Door Lock Switch – Passenger Ground	—	1	—	—
Drive Mode Select Switch Ground	—	1	—	—
Instrument Panel Dimmer Switch Ground	—	1	—	—
Multifunction Switch – Center Console Ground	—	1	—	—
Park Break Control Switch Ground	—	1	—	—
Seat Heating Switch – Driver Ground	—	1	—	—
Seat Heating Switch – Passenger Ground	—	1	—	—
Steering Wheel Controls Switch – Left Ground	—	1	—	—
Steering Wheel Controls Switch – Right Ground	—	1	—	—
Transmission Shift Lever Ground	—	1	—	—
1. Interior Backlighting Malfunction				

Circuit/System Description

The instrument panel dimmer switch is used to increase and decrease the brightness of the interior backlighting components. The instrument panel dimmer switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides a low reference signal and a B+ voltage reference to the instrument panel dimmer switch. When the instrument panel dimmer switch is placed in the desired position, the dimmed voltage setting is applied from the instrument panel dimmer switch through the instrument panel dimmer switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated (PWM) voltage through the LED dimming 1 and dimming 2 control circuits illuminating the interior backlighting to the requested level of brightness.

Conditions for Running the DTC

- Battery voltage must be between 9–16 V.
- Park lamps ON.

Conditions for Setting the DTC

DTC B2610 01

The BCM detects a short to battery in the LED backlight dimming control circuit terminal 8 X2.

DTC B2610 02

The BCM detects a short to ground in the LED backlight dimming control circuit terminal 8 X2.

DTC B2610 04

The BCM detects an open/high resistance in the LED backlight dimming control circuit terminal 8 X2.

Actions Taken When the DTC Sets

The BCM will disable the LED backlight dimming control circuits.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction–free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Interior Lights Dimming Schematics on page 4-76

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Interior Lighting Systems Description and Operation on page 4-200

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

Note: Each component with backlighting may need to be disconnected to isolate a short to voltage or short to ground. Use the schematics to identify the following:

- Backlighting components the vehicle is equipped with
- Each component's control and ground circuit terminals
- Component locations on the backlighting control circuit

1. Vehicle OFF, all doors closed, all accessories OFF, disconnect the harness connector at the component with inoperative backlighting. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 15 Ω between the appropriate ground circuit terminal listed below and ground.
   - S13D Door Lock Switch – Driver terminal 3
   - S13P Door Lock Switch – Passenger terminal 3
   - S126 Drive Mode Select Switch terminal 4
   - S36 Instrument Panel Dimmer Switch terminal 4
   - S48E Multifunction Switch – Center Console terminal 9
   - S91 Park Brake Control Switch terminal 8
   - S32D Seat Heating Switch – Driver terminal 5
   - S32P Seat Heating Switch – Passenger terminal 5
   - S70L Steering Wheel Controls Switch – Left terminal 2
   - S70R Steering Wheel Controls Switch – Right terminal 2
   - S3 Transmission Shift Lever terminal 3

⇒ **If 15 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 15 Ω**

3. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
   - S13D Door Lock Switch – Driver terminal 1
   - S13P Door Lock Switch – Passenger terminal 1
   - S126 Drive Mode Select Switch terminal 3
   - S36 Instrument Panel Dimmer Switch terminal 3
   - S48E Multifunction Switch – Center Console terminal 10
   - S91 Park Brake Control Switch terminal 6
   - S32D Seat Heating Switch – Driver terminal 6
   - S32P Seat Heating Switch – Passenger terminal 6
   - S70L Steering Wheel Controls Switch – Left terminal 1
   - S70R Steering Wheel Controls Switch – Right terminal 1
   - S3 Transmission Shift Lever terminal 1
4. Verify the test lamp turns ON and OFF when commanding the LED Backlight Dimming ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

4.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

5. Test or replace the component with inoperative backlighting.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Door Lock Switch Replacement on page 4-281*
- *Cruise Control Switch Replacement on page 9-47*
- *Radio Control Switch Replacement on page 8-63*
- *Front Seat Heater Switch Replacement on page 13-31*
- *Parking Brake Actuator Switch Replacement on page 5-265*
- *Fuel Economy Switch Replacement on page 8-98*
- *Control Module References on page 6-3* for BCM or HVAC control module replacement, programming, and setup

DTC B2615

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptor

DTC B2615 02: Passenger Compartment Dimming 2 Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F6DA (BCM 6) Fuse B+	B2545 01, B2545 04, B2615 02	B2545 01, B2545 04, B2615 02	—	—
Dome Lamp Control	B2615 02	2	2	—
Reading Lamp Control	B1480 02	1	1	—
Dome Lamp Ground	—	1, 2	—	—
1. Courtesy Lamps Malfunction 2. Dome Lamps Malfunction				

Circuit/System Description

The body control module (BCM) applies battery voltage to the dome/reading lamps through the dome/reading lamp control circuit. When any door is opened, the jam switch contacts close and the BCM receives a door-ajar input. If the BCM receives a door lock or unlock input or a rear hatch open input, the BCM will activate the dome/reading lamp control circuit, providing battery voltage to dome/reading lamps. In the event that any of these courtesy lamps were to remain illuminated for more than 10 minutes with the vehicle ON/OFF switch in the OFF position and no doors opened, the BCM will deactivate the courtesy lamp control circuit to prevent total battery discharge.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

- The BCM detects a short to ground in the dome lamp control circuit.
- The BCM detects a short to ground or an open/high resistance in the F6DA (BCM 6) fuse B+ circuit.

Actions Taken When the DTC Sets

The BCM will disable the dome lamps control circuit.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction–free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

- *Interior Lights Schematics on page 4-74*
- *Body Control System Schematics on page 11-14*

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Interior Lighting Systems Description and Operation on page 4-200

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

2.1. Vehicle OFF.

2.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If the test lamp illuminates**

3. Vehicle OFF, connect the X5 harness connector at the K9 Body Control Module.
4. Vehicle OFF, all doors closed, all accessories OFF, disconnect the harness connector at the E36AH Dome Lamp. It may take up to 2 min for all vehicle systems to power down.
5. Test for less than 10 Ω between the appropriate ground circuit terminal listed below and ground.
   - E36AH Dome Lamp – terminal 1 with UE1
   - E36AH Dome Lamp – terminal 2 without UE1

⇒ **If 10 Ω or greater**

5.1. Vehicle OFF.

5.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

6. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
   - E36AH Dome Lamp – terminal 2 with UE1
   - E36AH Dome Lamp – terminal 3 without UE1
7. Verify the test lamp turns ON and OFF when commanding the Courtesy Lamps ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

7.1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.

7.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

7.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

7.1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.

7.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

8. Test or replace the E36AH Dome Lamp.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Center Courtesy Lamp Bulb Replacement on page 4-177*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC B2645

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B2645 03: Ambient Light Sensor Circuit Low Voltage
DTC B2645 07: Ambient Light Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ambient Light Sensor Signal	B2645 03	B2645 07	B2645 07	—
Daytime Running Lamp Control - Left	2	2	2	—
Daytime Running Lamp Control - Right	2	2	2	—
Low Beam Headlamp Control - Left	1	1	1	—
Low Beam Headlamp Control - Right	1	1	1	—
Ambient Light Sensor Low Reference	2	B2645 07, B0163 05, B0183 05	2	—
Daytime Running Lamp Ground - Left	—	2	—	—
Daytime Running Lamp Ground - Right	—	2	—	—
Headlamp Ground - Left	—	1	—	—
Headlamp Ground - Right	—	1	—	—
1. Headlamps Malfunction 2. Daytime Running Lamps Malfunction				

Circuit/System Description

The ambient light sensor is used to monitor outside lighting conditions. The ambient light sensor provides a voltage signal that will vary between 0.2 and 4.9 volts depending on outside lighting conditions. The body control module (BCM) provides a 5-volt reference signal to the ambient light sensor and the HVAC control module provides a low reference ground. The BCM monitors the ambient light sensor signal circuit to determine if outside lighting conditions are correct for either daytime running lights (DRL) or the automatic headlamp system when the headlamp switch is in the AUTO position. In daylight conditions, the BCM will command the DRLs ON by applying voltage to the left and right DRL control circuits illuminating the DRLs. Any function or condition that turns on the headlamps will cancel DRL operation.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

DTC B2645 03

The BCM detects a short to ground in the ambient light sensor signal circuit.

DTC B2645 07

- The BCM detects a short to voltage or an open/high resistance in the ambient light sensor signal circuit.
- The BCM detects an open/high resistance in the ambient light sensor low reference circuit.

Actions Taken When the DTC Sets

- Automatic headlamp system and daytime running lamps are inoperative.
- The BCM defaults to low light status and commands the low beam headlamps ON.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics on page 4-67

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, open and close drivers door, disconnect the harness connector at the B10B Ambient Light/Sunload Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 15 Ω between the low reference circuit terminal 6 and ground.

⇒ **If 15 Ω or greater**

2.1. Vehicle OFF, disconnect the X1 harness connector at the K33 HVAC Control Module, vehicle in Service Mode.

2.2. Test for less than 1 V between the low reference circuit terminal 6 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

2.3. Test for less than 2 Ω in the low reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K33 HVAC Control Module.

⇓ **If less than 15 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Ambient Light Sensor parameter is greater than 4.65 V.

⇒ **If 4.65 V or less**

4.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit terminal 5 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If greater than 4.65 V**

5. Install a 3 A fused jumper wire between the signal circuit terminal 5 and the low reference circuit terminal 6.
6. Verify the scan tool Ambient Light Sensor parameter is less than 0.196 V.

⇒ **If 0.196 V or greater**

6.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit terminal 5 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If less than 0.196 V**

7. Test or replace the B10B Ambient Light/Sunload Sensor.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Sun Load Temperature Sensor Replacement on page 10-144*
- *Control Module References on page 6-3* for BCM or HVAC control module replacement, programming, and setup

DTC B2652

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptor

DTC B2652 02: Passenger Compartment Dimming 3 Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Hazard Warning Switch LED Backlight Dimming Control	B2652 02	1	1	—
Hazard Warning Switch Ground	—	1	—	—
1. Interior Backlighting Malfunction				

Circuit/System Description

The instrument panel dimmer switch is used to increase and decrease the brightness of the interior backlighting components. The instrument panel dimmer switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides a low reference signal and a B+ voltage reference to the instrument panel dimmer switch. When the instrument panel dimmer switch is placed in the desired position, the dimmed voltage setting is applied from the instrument panel dimmer switch through the instrument panel dimmer switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated (PWM) voltage through the LED dimming 1 and dimming 2 control circuits illuminating the interior backlighting to the requested level of brightness.

Conditions for Running the DTC

- Battery voltage must be between 9–16 V.
- Park lamps ON.

Conditions for Setting the DTC

The BCM detects a short to ground in the hazard warning switch backlight dimming control circuit.

Actions Taken When the DTC Sets

The BCM will disable the hazard warning switch backlight dimming control circuit.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction–free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Interior Lights Dimming Schematics on page 4-76

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Interior Lighting Systems Description and Operation on page 4-200

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S26 Hazard Warning Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 3 and ground.

⇒ **If 5 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

3. Connect a test lamp between the control circuit terminal 2 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the Hazard Lamps Switch Backlight ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

4.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

5. Test or replace the S26 Hazard Warning Switch.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Hazard Warning Switch Replacement on page 4-173*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC B3588

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptor

DTC B3588 00: Rear Fog Lamp Switch Circuit Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Rear Fog Lamp Switch Signal	B3588 00	1	1	—
Rear Fog Lamp Control	B2540 02	B2540 04	1	—
Rear Fog Lamp Ground	—	1	—	—
Turn Signal/Multifunction Switch Ground	—	1	—	—
1. Rear Fog Lamp Malfunction				

Circuit/System Description

The rear fog lamp switch signal circuit is grounded momentarily by pressing the rear fog lamp switch. The body control module (BCM) responds to the rear fog lamp request by applying voltage to the rear fog lamp control circuit which illuminates the rear fog lamp.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

The BCM detects a short to ground in the turn signal/ multifunction switch rear fog lamp signal circuit.

Actions Taken When the DTC Sets

The rear fog lamp indicator on the instrument cluster is always ON.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Fog Lights Schematics on page 4-69

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/ Multifunction Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 15 Ω between the ground circuit terminal 1 and ground.

⇒ **If 15 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 15 Ω**

3. Vehicle in Service Mode.

4. Verify the scan tool Rear Fog Lamp Switch parameter is Inactive.

⇒ **If not Inactive**

4.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit terminal 9 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 9 and the ground circuit terminal 1.

6. Verify the scan tool Rear Fog Lamp Switch parameter is Active.

⇒ **If not Active**

6.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit terminal 9 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

7. Test or replace the S78 Turn Signal/Multifunction Switch.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Turn Signal Switch Replacement on page 14-31*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC B3596

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptor

DTC B3596 00: Hazard Lamps Request Circuit Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Hazard Warning Switch Signal	1	1	1	B3596 00
Hazard Warning Switch LED Backlighting Control	B2652 02	2	2	—
Hazard Warning Switch Ground	—	1	—	—
1. Hazard Lamps Malfunction 2. Hazard Warning Switch Backlighting Malfunction				

Circuit/System Description

The hazard flashers may be activated in any power mode. The hazard warning switch signal circuit is momentarily grounded when the hazard warning switch is pressed. The body control module (BCM) responds to the hazard warning switch signal input by supplying battery voltage to all four turn signal lamps in an ON and OFF duty cycle. When the hazard warning switch is activated, the BCM sends a serial data message to the instrument cluster requesting both turn signal indicators to be cycled ON and OFF.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Hazard lamps ON.

Conditions for Setting the DTC

The hazard warning switch input is Active for longer than 60 seconds.

Actions Taken When the DTC Sets

The hazard warning lamps are inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Exterior Lights Schematics on page 4-70

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S26 Hazard Warning Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 8 and ground.

⇒ **If 5 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Hazard Lamps Switch parameter is Inactive.

⇒ **If not Inactive**

4.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit terminal 7 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 7 and ground.
6. Verify the scan tool Hazard Lamps Switch parameter is Active.

⇒ **If not Active**

6.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit terminal 7 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

7. Test or replace the S26 Hazard Warning Switch.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Hazard Warning Switch Replacement on page 4-173*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC B3600

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B3600 03: Passenger Compartment Dimming Request Signal Circuit Low Voltage

DTC B3600 07: Passenger Compartment Dimming Request Signal Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F1DA (BCM 1) Fuse B+	B101E 43, B1395 03, B1517 07, C0890 03, U0121 00,	B101E 43, B1395 03, B1517 07, C0890 03, U0121 00,	—	—
Instrument Panel Dimmer Switch B+ Reference	B1395 03, B3600 03,	B3600 03	B1395 07	—
Instrument Panel Dimmer Switch Signal	B1395 03, B3600 03,	B3600 03	B3600 07	—
Instrument Panel Dimmer Switch Low Reference	1	1	1	—
1. Interior Backlighting Malfunction				

Circuit/System Description

The instrument panel dimmer switch is used to increase and decrease the brightness of the interior backlighting components. The instrument panel dimmer switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides a low reference signal and a B+ voltage reference to the instrument panel dimmer switch. When the instrument panel dimmer switch is placed in the desired position, the dimmed voltage setting is applied from the instrument panel dimmer switch through the instrument panel dimmer switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated (PWM) voltage through the LED dimming 1 and dimming 2 control circuits illuminating the interior backlighting to the requested level of brightness.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Park Lamps ON.

Conditions for Setting the DTC

DTC B3600 03

- The BCM detects a short to ground or an open/high resistance in the instrument panel dimmer switch B+ reference circuit.
- The BCM detects a short to ground or an open/high resistance in the instrument panel dimmer switch signal circuit.

DTC B3600 07

The BCM detects a short to voltage in the instrument panel dimmer switch signal circuit.

Actions Taken When the DTC Sets

The BCM will not dim any interior backlighting. All interior backlighting will default to maximum brightness.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

- *Interior Lights Dimming Schematics on page 4-76*
- *Body Control System Schematics on page 11-14*

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Interior Lighting Systems Description and Operation on page 4-200

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the S16 Driver Information Center Switch, vehicle in Service Mode.
2. Verify a test lamp illuminates between the low reference circuit terminal 12 and B+.

⇒ **If the test lamp does not illuminate**

2.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

2.2. Test for less than 1 V between the low reference circuit terminal 12 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

2.3. Test for less than 2 Ω in the low reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If the test lamp illuminates**

3. Test for B+ between the B+ reference circuit terminal 11 and ground.

⇒ **If less than B+**

3.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.

3.2. Test for infinite resistance between the B+ reference circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

3.3. Test for less than 2 Ω in the B+ reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If B+**

4. Verify a test lamp does not illuminate between the B+ reference circuit terminal 11 and ground.

⇒ **If the test lamp illuminates**

4.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the B+ reference circuit terminal 11 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp does not illuminate**

5. Park lamps ON, verify a test lamp does not illuminate between the signal circuit terminal 10 and ground.

⇒ **If the test lamp illuminates**

5.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.

5.2. Test for less than 1 V between the signal circuit terminal 10 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp does not illuminate**

6. Vehicle in Service Mode, park lamps OFF, test for between 57.4 K ohms and 58 K ohms between the signal circuit terminal 10 and ground.

⇒ **If not between 57.4 K ohms and 58 K ohms**

6.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.

6.2. Test for infinite resistance between the signal circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If between 57.4 K ohms and 58 K ohms**

7. Test or replace the S16 Driver Information Center Switch.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Driver Information Display Switch Replacement on page 8-93*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC B3650

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptor

DTC B3650 08: High Beam Request Signal Circuit Performance – Signal Invalid

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp Switch Headlamps ON Signal	B257A 00	1	1	—
Headlamp Switch Park Lamps ON Signal	2	B257A 00	2	—
Turn Signal/Multifunction Switch Flash To Pass Signal	B3806 00	1	1	—
Turn Signal/Multifunction Switch High Beam Signal	B3650 08	1	1	—
Turn Signal/Multifunction Switch Ground	—	1	—	—
1. Headlamps Malfunction 2. Park, License, and/or Tail Lamps Malfunction				

Circuit/System Description

When the low beam headlamps are on and the turn signal/multifunction switch is placed in the high beam position, ground is applied to the body control module (BCM) through the high beam signal circuit. The BCM responds to the high beam request by applying ground to the high beam relay control circuit which energizes the high beam relay. With the high beam relay energized, the switch contacts close allowing battery voltage to flow through the high beam fuses to the high beam control circuits illuminating the high beam headlamps.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

The BCM detects a short to ground in the turn signal/multifunction switch high beam signal circuit.

Actions Taken When the DTC Sets

The high beam headlamps will not operate.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics on page 4-67

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/ Multifunction Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 15 Ω between the ground circuit terminal 1 and ground.

⇒ **If 15 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 15 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool High Beam Select Switch parameter is Inactive.

⇒ **If not Inactive**

4.1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit terminal 6 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 6 and the ground circuit terminal 1.
6. Verify the scan tool High Beam Select Switch parameter is Active.

⇒ **If not Active**

6.1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit terminal 6 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

7. Test or replace the S78 Turn Signal/Multifunction Switch.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Turn Signal Switch Replacement on page 14-31*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC B3806

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptor

DTC B3806 00: High Beam and Headlamp Flash Select Circuit Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp Switch Headlamps ON Signal	B257A 00	1	1	—
Headlamp Switch Park Lamps ON Signal	2	B257A 00	2	—
Turn Signal/Multifunction Switch Flash To Pass Signal	B3806 00	1	1	—
Turn Signal/Multifunction Switch High Beam Signal	B3650 08	1	1	—
Turn Signal/Multifunction Switch Ground	—	1	—	—
1. Headlamps Malfunction 2. Park, License, and/or Tail Lamps Malfunction				

Circuit/System Description

When the turn signal/multifunction switch is momentarily placed in the flash to pass position, ground is applied to the body control module (BCM) through the flash to pass signal circuit. The BCM responds to the flash to pass request by applying ground to the high beam relay control circuit which energizes the high beam relay. With the high beam relay energized, the switch contacts close allowing battery voltage to flow through the high beam fuses to the high beam control circuits illuminating the high beam headlamps. The high beam headlamps will only illuminate for as long at the flash to pass switch is activated.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

The BCM detects a short to ground in the turn signal/ multifunction switch flash to pass signal circuit.

Actions Taken When the DTC Sets

The high beam lamps and the high beam indicator on the instrument cluster are always ON.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics on page 4-67

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/ Multifunction Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 15 Ω between the ground circuit terminal 1 and ground.

⇒ **If 15 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 15 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Headlamps Flash Switch parameter is Inactive.

⇒ **If not Inactive**

4.1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit terminal 7 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 7 and the ground circuit terminal 1.
6. Verify the scan tool Headlamps Flash Switch parameter is Active.

⇒ **If not Active**

6.1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit terminal 7 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

7. Test or replace the S78 Turn Signal/Multifunction Switch.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Turn Signal Switch Replacement on page 14-31*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC B3881 or B3882

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B3881 01: Tail Lamp Circuit Short to Battery
DTC B3881 02: Tail Lamp Circuit Short to Ground
DTC B3881 04: Tail Lamp Circuit Open
DTC B3882 01: Right Tail Lamp Circuit Short to Battery
DTC B3882 02: Right Tail Lamp Circuit Short to Ground
DTC B3882 04: Right Tail Lamp Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F5DA (BCM 5) Fuse B+	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	—	—
Brake Pedal Position Sensor 5 V Reference	C0277 06, C0890 03, C0161 71	C0277 06, C0161 71	C0890 07, C0161 71	—
Brake Pedal Position Sensor Signal	C0277 06, C0161 71	C0277 06, C0161 71	C0277 07, C0161 71	C0277 09
Center High Mounted Stop Lamp Control	B3884 02	2	2	—
Stop Lamp Control – Left	B3881 02	B3881 01, B3881 04	B3881 01	—
Stop Lamp Control – Right	B3882 02	B3882 01, B3882 04	B3882 01	—
Brake Pedal Position Sensor Low Reference	—	C0277 07, C0161 71	1	—
Center High Mounted Stop Lamp Ground	—	2	—	—
Rear Tail/Stop Lamp Ground – Left	—	1	—	—
Rear Tail/Stop Lamp Ground – Right	—	1	—	—
1. Stop Lamps Malfunction 2. Center High Mounted Stop Lamp Malfunction				

Circuit/System Description

The brake pedal position (BPP) sensor is used to sense the action of the driver application of the brake pedal. The BPP sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5-volt reference voltage to the BPP sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the left and right stop lamp control circuits as well as the center high mounted stop lamp (CHMSL) control circuit illuminating the left and right stop lamps and the CHMSL.

Conditions for Running the DTC

- Battery voltage must be between 9–16 V.
- Brakes APPLIED.

Conditions for Setting the DTC

DTC B3881 01 and B3881 04

- The BCM detects a short to voltage or an open/high resistance in the left stop lamp control circuit.
- The BCM detects a short to ground or an open/high resistance in the F5DA (BCM 5) fuse B+ circuit.

DTC B3881 02

The BCM detects a short to ground in the left stop lamp control circuit.

DTC B3882 01

The BCM detects a short to voltage in the right stop lamp control circuit.

DTC B3882 02

The BCM detects a short to ground in the right stop lamp control circuit.

DTC B3882 04

The BCM detects an open/high resistance in the right stop lamp control circuit.

Actions Taken When the DTC Sets

The appropriate stop lamp will not operate.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Diagnostic Aids

When testing at the stop lamp bulb socket, make sure all measurements and test lamp connections are in the correct terminal location and do not come in contact with each other during testing.

Reference Information

Schematic Reference

- *Exterior Lights Schematics on page 4-70*
- *Body Control System Schematics on page 11-14*

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

DTC B3881

1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

2.1. Vehicle OFF.

2.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If the test lamp illuminates**

3. Vehicle OFF, connect the X2 harness connector at the K9 Body Control Module.
4. Disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
5. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

5.1. Vehicle OFF.

5.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

5.1. Vehicle OFF.

5.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If the test lamp illuminates**

6. Vehicle OFF, connect the X1 harness connector at the K9 Body Control Module.
7. Vehicle OFF, exterior lamps OFF, remove the E5AA Tail/Stop Lamp – Left bulb. It may take up to 2 minutes for all vehicle systems to power down.

8. Test for less than 5 Ω between the ground circuit at the socket terminal and ground.

⇒ **If 5 Ω or greater**

8.1. Vehicle OFF.

8.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

9. Connect a test lamp between the control circuit at the socket terminal and ground, vehicle in Service Mode.
10. Verify the test lamp turns ON and OFF when commanding the Left Brake Lamp ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

10.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.

10.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

10.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

10.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.

10.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

11. Test or replace the E5AA Tail/Stop Lamp – Left.

DTC B3882

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

2.1. Vehicle OFF.

2.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If the test lamp illuminates**

3. Vehicle OFF, connect the X1 harness connector at the K9 Body Control Module.
4. Vehicle OFF, exterior lamps OFF, remove the E5AB Tail/Stop Lamp – Right bulb. It may take up to 2 minutes for all vehicle systems to power down.
5. Test for less than 5 Ω between the ground circuit at the socket terminal and ground.

⇒ **If 5 Ω or greater**

5.1. Vehicle OFF.

5.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

6. Connect a test lamp between the control circuit at the socket terminal and ground, vehicle in Service Mode.
7. Verify the test lamp turns ON and OFF when commanding the Right Brake Lamp ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

7.1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module.

7.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

7.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

7.1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.

7.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

8. Test or replace the E5AB Tail/Stop Lamp – Right.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Tail Lamp Replacement on page 4-192*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC B3883

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B3883 01: License Plate Lamp Circuit Short to Battery

DTC B3883 02: License Plate Lamp Circuit Short to Ground

DTC B3883 04: License Plate Lamp Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
License Plate Lamp Control	B3883 02	B3883 01, B3883 04	B3883 01, B3883 04	—
License Plate Lamp Ground	—	B3883 01, B3883 04	—	—

Circuit/System Description

When the headlamp switch is placed in the HEAD or PARK position, ground is applied to the park lamp switch ON signal circuit to the body control module (BCM). The BCM responds by applying voltage to the park lamps, tail lamps, and license lamps control circuits illuminating the park, tail, and license lamps.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

DTC B3883 01

Headlamp switch in OFF position.

DTC B3883 02 or B3883 04

Headlamp switch in PARK or ON positions.

Conditions for Setting the DTC

DTC B3883 01

- The BCM detects a short to voltage in the license lamp control circuit.
- The BCM detects an open/high resistance in the license lamp ground circuit.

DTC B3883 02

The BCM detects a short to ground in the license lamp control circuit.

DTC B3883 04

- The BCM detects an open/high resistance in the license lamp control circuit.
- The BCM detects an open/high resistance in the license lamp ground circuit.

Actions Taken When the DTC Sets

DTC B3883 01

License lamp always ON.

DTC B3883 02 or B3883 04

License lamp inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Exterior Lights Schematics on page 4-70

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, exterior lamps OFF, remove the E7 License Plate Lamp Bulb. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 1 and ground.

⇒ **If 5 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

3. Connect a test lamp between the control circuit terminal 2 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the License Plate Lamps ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

4.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

5. Test or replace the E7 License Plate Lamp Bulb.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Rear License Plate Lamp Replacement on page 4-191*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC B3884

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptor

DTC B3884 02: Center High Mounted Brake Lamp Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Center High Mounted Stop Lamp Control	B3884 02	1	1	—
Center High Mounted Stop Lamp Ground	—	1	—	—
1. Stop Lamps Malfunction				

Circuit/System Description

The brake pedal position sensor is used to sense the action of the driver application of the brake pedal. The brake pedal position sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5 V reference voltage to the brake pedal position sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the right and left stop lamp control circuits, engine control module (ECM), and center high mounted stop lamp control circuit.

Conditions for Running the DTC

- Battery voltage must be between 9–16 V.
- Brakes APPLIED.

Conditions for Setting the DTC

The BCM detects a short to ground in the center high mounted stop lamp control circuit.

Actions Taken When the DTC Sets

The BCM will not illuminate the center high mounted stop lamp.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Exterior Lights Schematics on page 4-70

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E6 Center High Mounted Stop Lamp. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 2 and ground.

⇒ **If 5 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

3. Connect a test lamp between the control circuit terminal 1 and ground, vehicle in Service Mode.

4. Verify the test lamp turns ON and OFF when commanding the Center Brake Lamp ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

4.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

5. Test or replace the E6 Center High Mounted Stop Lamp.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *High Mount Stop Lamp Replacement on page 4-189*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC B3948 or B3949

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B3948 01: Left Front Turn Signal Circuit Short to Battery
DTC B3948 02: Left Front Turn Signal Circuit Short to Ground
DTC B3948 04: Left Front Turn Signal Circuit Open
DTC B3949 01: Right Front Turn Signal Circuit Short to Battery
DTC B3949 02: Right Front Turn Signal Circuit Short to Ground
DTC B3949 04: Right Front Turn Signal Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F5DA (BCM 5) Fuse B+	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	—	—
F7DA (BCM 7) Fuse B+	B3948 01, B3948 04, B3951 01, B3951 04	B3948 01, B3948 04, B3951 01, B3951 04	—	—
Turn Signal Switch Signal – Left	1	1	1	—
Turn Signal Switch Signal – Right	1	1	1	—
Turn Signal Control – Left Front	B3948 02	B3948 01, B3948 04	B3948 01, B3948 04	—
Turn Signal Control – Left Rear	B3950 02	B3950 01, B3950 04	B3950 01, B3950 04	—
Turn Signal Control – Right Front	B3949 02	B3949 01, B3949 04	B3949 01, B3949 04	—
Turn Signal Control – Right Rear	B3951 02	B3951 01, B3951 04	B3951 01, B3951 04	—
Turn Signal Lamp Ground – Left Front	—	B3948 01, B3948 04	—	—
Turn Signal Lamp Ground – Right Front	—	B3949 01, B3949 04	—	—
Turn Signal Lamp Ground – Left Rear	—	B3950 01, B3950 04	—	—
Turn Signal Lamp Ground – Right Rear	—	B3951 01, B3951 04	—	—
Turn Signal Repeater Lamp Ground – Left – with T90	—	B3948 01, B3948 04	—	—
Turn Signal Repeater Lamp Ground – Right – with T90	—	B3949 01, B3949 04	—	—
Turn Signal/Multifunction Switch Ground	—	1	—	—
1. Turn Signal Lamps and/or Indicators Malfunction				

Circuit/System Description

Ground is applied at all times to the turn signal/ multifunction switch. The turn signal lamps may only be activated with the vehicle ON/OFF switch in the Service Mode or ON positions. When the turn signal/ multifunction switch is placed in either the turn left or turn right position, ground is applied to the body control module (BCM) through either the right turn or left turn signal switch signal circuit. The BCM responds to the turn signal switch input by applying a pulsating voltage to the front and rear turn signal lamps through there respective control circuits. When a turn signal request is received by the BCM, a serial data message is sent to the instrument cluster requesting the respective turn signal indicator be pulsed ON and OFF.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Vehicle ON.

Conditions for Setting the DTC

DTC B3948 01 and B3948 04

- The BCM detects an open/high resistance in the left front turn signal control circuit.
- The BCM detects an open/high resistance in the left front turn signal ground circuit.
- The BCM detects a short to ground or an open/ high resistance in the F7DA (BCM 7) fuse B+ circuit.

DTC B3948 02

The BCM detects a short to ground in the left front turn signal control circuit.

DTC B3949 01 and B3949 04

- The BCM detects an open/high resistance in the right front turn signal control circuit.
- The BCM detects an open/high resistance in the right front turn signal ground circuit.
- The BCM detects a short to ground or an open/ high resistance in the F5DA (BCM 5) fuse B+ circuit.

DTC B3949 02

The BCM detects a short to ground in the right front turn signal control circuit.

Actions Taken When the DTC Sets

DTC B3948

- The left front turn signal is inoperative.
- The left turn signal indicator on the instrument cluster flashes rapidly.

DTC B3949

- The right front turn signal is inoperative.
- The right turn signal indicator on the instrument cluster flashes rapidly.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Diagnostic Aids

When testing at the turn signal lamp bulb socket, make sure all measurements and test lamp connections are in the correct terminal location and do not come in contact with each other during testing.

Reference Information

Schematic Reference

- *Exterior Lights Schematics on page 4-70*
- *Body Control System Schematics on page 11-14*

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

DTC B3948

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

2.1. Vehicle OFF.

2.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If the test lamp illuminates**

3. Vehicle OFF, connect the X5 harness connector at the K9 Body Control Module.
4. Vehicle OFF, exterior lamps OFF, remove the appropriate E4 Turn Signal Lamp bulb – Left front. It may take up to 2 min for all vehicle systems to power down.
5. Test for less than 5 Ω between the appropriate ground circuit terminal listed below and ground.
   - E4N Park/Turn Signal Lamp – Left socket terminal C
   - E4Y Turn Signal Repeater Lamp – Left socket terminal 2

⇒ **If 5 Ω or greater**

5.1. Vehicle OFF.

5.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

6. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
   - E4N Park/Turn Signal Lamp – Left socket terminal A
   - E4Y Turn Signal Repeater Lamp – Left socket terminal 1
7. Verify the test lamp turns ON and OFF when commanding the Left Front Turn Signal Lamp ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

7.1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module.

7.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

7.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

7.1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.

7.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

8. Test or replace the appropriate E4 Turn Signal Lamp bulb – Left front.

DTC B3949

1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

2.1. Vehicle OFF.

2.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If the test lamp illuminates**

3. Vehicle OFF, connect the X2 harness connector at the K9 Body Control Module.
4. Vehicle OFF, exterior lamps OFF, remove the E4P Turn Signal Lamp bulb – Right front. It may take up to 2 min for all vehicle systems to power down.
5. Test for less than 5 Ω between the appropriate ground circuit terminal listed below and ground.
   - E4P Park/Turn Signal Lamp – Right socket terminal C
   - E4Z Turn Signal Repeater Lamp – Right socket terminal 2

⇒ **If 5 Ω or greater**

5.1. Vehicle OFF.

5.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

6. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
   - E4P Park/Turn Signal Lamp – Right socket terminal A
   - E4Z Turn Signal Repeater Lamp – Right socket terminal 1
7. Verify the test lamp turns ON and OFF when commanding the Right Front Turn Signal Lamp ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

7.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.

7.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

7.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

7.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.

7.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

8. Test or replace the appropriate E4 Turn Signal Lamp bulb – Right front.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Front Turn Signal Lamp Bulb Replacement (North America) on page 4-187* or *Front Turn Signal Lamp Bulb Replacement (Europe, Korea) on page 4-188*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC B3950 or B3951

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B3950 01: Left Rear Turn Signal Circuit Short to Battery
DTC B3950 02: Left Rear Turn Signal Circuit Short to Ground
DTC B3950 04: Left Rear Turn Signal Circuit Open
DTC B3951 01: Right Rear Turn Signal Circuit Short to Battery
DTC B3951 02: Right Rear Turn Signal Circuit Short to Ground
DTC B3951 04: Right Rear Turn Signal Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F5DA (BCM 5) Fuse B+	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	—	—
F7DA (BCM 7) Fuse B+	B3948 01, B3948 04, B3951 01, B3951 04	B3948 01, B3948 04, B3951 01, B3951 04	—	—
Turn Signal Switch Signal – Left	1	1	1	—
Turn Signal Switch Signal – Right	1	1	1	—
Turn Signal Control – Left Front	B3948 02	B3948 01, B3948 04	B3948 01, B3948 04	—
Turn Signal Control – Left Rear	B3950 02	B3950 01, B3950 04	B3950 01, B3950 04	—
Turn Signal Control – Right Front	B3949 02	B3949 01, B3949 04	B3949 01, B3949 04	—
Turn Signal Control – Right Rear	B3951 02	B3951 01, B3951 04	B3951 01, B3951 04	—
Turn Signal Lamp Ground – Left Front	—	B3948 01, B3948 04	—	—
Turn Signal Lamp Ground – Right Front	—	B3949 01, B3949 04	—	—
Turn Signal Lamp Ground – Left Rear	—	B3950 01, B3950 04	—	—
Turn Signal Lamp Ground – Right Rear	—	B3951 01, B3951 04	—	—
Turn Signal Repeater Lamp Ground – Left – with T90	—	B3948 01, B3948 04	—	—
Turn Signal Repeater Lamp Ground – Right – with T90	—	B3949 01, B3949 04	—	—
Turn Signal/Multifunction Switch Ground	—	1	—	—
1. Turn Signal Lamps and/or Indicators Malfunction				

Circuit/System Description

Ground is applied at all times to the turn signal/ multifunction switch. The turn signal lamps may only be activated with the vehicle ON/OFF switch in the vehicle Service Mode or ON positions. When the turn signal/ multifunction switch is placed in either the turn right or turn left position, ground is applied to the body control module (BCM) through either the right turn or left turn signal switch signal circuit. The BCM responds to the turn signal switch input by applying a pulsating voltage to the front and rear turn signal lamps through there respective control circuits. When a turn signal request is received by the BCM, a serial data message is sent to the instrument cluster requesting the respective turn signal indicator be pulsed ON and OFF.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Vehicle ON.

Conditions for Setting the DTC

DTC B3950 01 and B3950 04

- The BCM detects an open/high resistance in the left rear turn signal control circuit.
- The BCM detects an open/high resistance in the left rear turn signal ground circuit.
- The BCM detects a short to ground or an open/ high resistance in the F5DA (BCM 5) fuse B+ circuit.

DTC B3950 02

The BCM detects a short to ground in the left rear turn signal control circuit.

DTC B3951 01 and B3951 04

- The BCM detects an open/high resistance in the right rear turn signal control circuit.
- The BCM detects an open/high resistance in the right rear turn signal ground circuit.
- The BCM detects a short to ground or an open/ high resistance in the F7DA (BCM 7) fuse B+ circuit.

DTC B3951 02

The BCM detects a short to ground in the right rear turn signal control circuit.

Actions Taken When the DTC Sets

DTC B3950

- The left rear turn signal is inoperative.
- The left turn signal indicator on the instrument cluster flashes rapidly.

DTC B3951

- The right rear turn signal is inoperative.
- The right turn signal indicator on the instrument cluster flashes rapidly.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Diagnostic Aids

When testing at the turn signal lamp bulb socket, make sure all measurements and test lamp connections are in the correct terminal location and do not come in contact with each other during testing.

Reference Information

Schematic Reference

- *Exterior Lights Schematics on page 4-70*
- *Body Control System Schematics on page 11-14*

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

DTC B3950

1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

2.1. Vehicle OFF.

2.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If the test lamp illuminates**

3. Vehicle OFF, connect the X2 harness connector at the K9 Body Control Module.
4. Vehicle OFF, exterior lamps OFF, remove the E5AC Tail/Turn Signal Lamp bulb – Left rear. It may take up to 2 min for all vehicle systems to power down.
5. Test for less than 5 Ω between the ground circuit terminal G and ground.

⇒ **If 5 Ω or greater**

5.1. Vehicle OFF.

5.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

6. Connect a test lamp between the control circuit terminal A and ground, vehicle in Service Mode.
7. Verify the test lamp turns ON and OFF when commanding the Left Rear Turn Signal Lamp ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

7.1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module.

7.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

7.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

7.1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.

7.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

8. Test or replace the E5AC Tail/Turn Signal Lamp bulb – Left rear.

DTC B3951

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

2.1. Vehicle OFF.

2.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If the test lamp illuminates**

3. Vehicle OFF, connect the X5 harness connector at the K9 Body Control Module.
4. Vehicle OFF, exterior lamps OFF, remove the E5AD Tail/Turn Signal Lamp bulb – Right rear. It may take up to 2 min for all vehicle systems to power down.
5. Test for less than 5 Ω between the ground circuit terminal G and ground.

⇒ **If 5 Ω or greater**

5.1. Vehicle OFF.

5.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

6. Connect a test lamp between the control circuit terminal A and ground, vehicle in Service Mode.

7. Verify the test lamp turns ON and OFF when commanding the Right Rear Turn Signal Lamp ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

7.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.

7.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

7.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

7.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.

7.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

8. Test or replace the E5AD Tail/Turn Signal Lamp bulb – Right rear.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Stop and Tail Lamp Bulb Replacement (North America) on page 4-196* or *Stop and Tail Lamp Bulb Replacement (Europe, Korea) on page 4-197*
- *Tail and Turn Signal Lamp Bulb Replacement (North America) on page 4-193* or *Tail and Turn Signal Lamp Bulb Replacement (Europe, Korea) on page 4-194*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC C0277 or C0890

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C0277 06: Brake Pedal Position Sensor Circuit Low Voltage/Open
DTC C0277 07: Brake Pedal Position Sensor Circuit High Voltage
DTC C0277 09: Brake Pedal Position Sensor Circuit Too Fast Transitions
DTC C0277 4B: Brake Pedal Position Sensor Circuit Calibration Not Learned
DTC C0890 03: Control Module Voltage Reference Output 3 Circuit Low Voltage
DTC C0890 07: Control Module Voltage Reference Output 3 Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Pedal Position Sensor 5 V Reference	C0277 06, C0890 03, C0161 71	C0277 06, C0161 71	C0890 07, C0161 71	—
Brake Pedal Position Sensor Signal	C0277 06, C0161 71	C0277 06, C0161 71	C0277 07, C0161 71	C0277 09
Center High Mounted Stop Lamp Control	B3884 02	2	2	—
Stop Lamp Control – Left	B3881 02	B3881 04	B3881 01	—
Stop Lamp Control – Right	B3882 02	B3882 04	B3882 01	—
Brake Pedal Position Sensor Low Reference	—	C0277 07, C0161 71	1	—
Center High Mounted Stop Lamp Ground	—	2	—	—
Rear Tail/Stop Lamp Ground – Left	—	1	—	—
Rear Tail/Stop Lamp Ground – Right	—	1	—	—
1. Stop Lamps Malfunction 2. Center High Mounted Stop Lamp Malfunction				

Circuit/System Description

The brake pedal position (BPP) sensor is used to sense the action of the driver application of the brake pedal. The BPP sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5-volt reference voltage to the BPP sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the left and right stop lamp control circuits as well as the center high mounted stop lamp (CHMSL) control circuit illuminating the left and right stop lamps and the CHMSL.

Conditions for Running the DTC

- Battery voltage must be between 9–16 V.
- Brakes APPLIED.

Conditions for Setting the DTC

DTC C0277 06

- The BCM detects a short to ground or an open/high resistance in the BPP sensor 5 V reference circuit.
- The BCM detects a short to ground or an open/high resistance in the BPP sensor signal circuit.

DTC C0277 07

- The BCM detects a short to voltage in the BPP sensor 5 V reference circuit.
- The BCM detects a short to voltage in the BPP sensor signal circuit.

DTC C0277 09

The BCM detects the BPP sensor signal is changing faster than possible under normal operating conditions.

DTC C0277 4B

The DTC will set when the BPP sensor home position is not learned.

DTC C0890 03

The BCM detects a short to ground in the BPP sensor 5 V reference circuit.

DTC C0890 07

- The BCM detects a short to voltage in the BPP sensor 5 V reference circuit.
- The BCM detects a short to voltage in the BPP sensor low reference circuit.

Actions Taken When the DTC Sets

- The Traction Control indicator is commanded ON.
- For DTC C0277 4B, the stop lamps may not activate at the expected brake pedal positions.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- For DTC C0277 07 the ignition must be cycled before the code can be cleared.
- For DTC C0277 4B a successful brake pedal position sensor calibration has been performed.
- A history DTC will clear once 50 malfunction-free vehicle ON/OFF switch cycles have occurred.
- A DTC will not clear the current status until the next vehicle ON/OFF switch cycle.

Reference Information

Schematic Reference

Exterior Lights Schematics on page 4-70

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

DTC C0277 06, C0277 07, C0890 03, and C0890 07

1. Vehicle OFF, disconnect the harness connector at the B22 Brake Pedal Position Sensor, vehicle in Service Mode.
2. Verify a test lamp illuminates between the low reference circuit terminal A and B+.

⇒ **If the test lamp does not illuminate**

2.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.

2.2. Test for less than 2 Ω in the low reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If the test lamp illuminates**

3. Vehicle in Service Mode.
4. Test for 4.8–5.2 V between the 5 V reference circuit terminal C and ground.

⇒ **If less than 4.8 V**

4.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the 5 V reference circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the 5 V reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If greater than 5.2 V**

4.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the 5 V reference circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If between 4.8–5.2 V**

5. Verify the scan tool Brake Pedal Applied parameter is Inactive.

⇒ **If not Inactive**

5.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.

5.2. Test for less than 1 V between the signal circuit terminal B and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If Active**

6. Install a 3 A fused jumper wire between the 5 V reference circuit terminal C and the signal circuit terminal B.
7. Verify the scan tool Brake Pedal Applied parameter is Active.

⇒ **If not Active**

7.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.

7.2. Test for infinite resistance between the signal circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

7.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

8. Test or replace the B22 Brake Pedal Position Sensor.

DTC C0277 4B

1. Verify DTC C0277 4B is not set.

⇒ **If DTC C0277 4B is set**

1.1. Vehicle in Service Mode.

1.2. Perform the BPP sensor recalibration procedure for the K9 Body Control Module. Refer to *Brake Pedal Position Sensor Calibration on page 4-170*.

1.3. Verify the DTC does not reset while operating the vehicle under the conditions for running the DTC.

⇒ If the DTC resets, replace the B22 Brake Pedal Position Sensor.

⇓ If the DTC does not reset

1.4. All OK.

⇓ **If DTC C0277 4B is not set**

2. All OK.

DTC C0277 09

1. Verify DTC C0277 09 is not set.

⇒ **If DTC C0277 09 is set**

1.1. Replace the B22 Brake Pedal Position Sensor.

1.2. Perform the BPP sensor recalibration procedure for the K9 Body Control Module. Refer to *Brake Pedal Position Sensor Calibration on page 4-170*.

1.3. Verify the DTC does not reset while operating the vehicle under the conditions for running the DTC.

⇒ If the DTC resets, replace the K9 Body Control Module.

⇓ If the DTC does not reset

1.4. All OK.

⇓ **If DTC C0277 09 is not set**

2. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Brake Pedal Position Sensor Replacement (Travel Sensor) on page 4-170* or *Brake Pedal Position Sensor Replacement (Apply Sensor) on page 4-171*
- *Brake Pedal Position Sensor Calibration on page 4-170*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

DTC C0297

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptor

DTC C0297 02: Brake Applied Output Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Applied Signal	C0297 02	C0297 02	1	—
1. Cruise Control Malfunction				

Circuit/System Description

The brake pedal position sensor is used to sense the action of the driver application of the brake pedal. The brake pedal position sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5 V reference voltage to the brake pedal position sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the right and left stop lamp control circuits, engine control module (ECM), and center high mounted stop lamp control circuit.

Conditions for Running the DTC

- Battery voltage must be between 9–16 V.
- Brakes APPLIED.

Conditions for Setting the DTC

The BCM detects a short to ground or an open/high resistance on the brake applied signal circuit.

Actions Taken When the DTC Sets

The cruise control system is disabled.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 50 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Diagnostic Aids

Verify that the brake pedal position sensor is properly calibrated.

Reference Information

Schematic Reference

Cruise Control Schematics on page 9-39

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
2. Connect a test lamp between the signal circuit terminal 33 and ground, vehicle in Service Mode.
3. Verify the test lamp turns ON and OFF while pressing and releasing the brake pedal.

⇒ **If the test lamp is always OFF**

3.1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module.

3.2. Test for infinite resistance between the signal circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

3.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

3.1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.

3.2. Test for less than 1 V between the signal circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

4. Replace the K20 Engine Control Module.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Brake Pedal Position Sensor Calibration on page 4-170*
- *Control Module References on page 6-3* for BCM or ECM replacement, programming, and setup

Symptoms - Lighting

Note: The following steps must be completed before using a symptom table.

- Perform the *Diagnostic System Check - Vehicle on page 6-91* before using a symptom table in order to verify that all of the following conditions are true:
  - There are no DTCs set.
  - The control modules can communicate via the serial data link.
- Review the system description and operation in order to familiarize yourself with the system functions. Refer to the following:
  - *Exterior Lighting Systems Description and Operation on page 4-198*
  - *Interior Lighting Systems Description and Operation on page 4-200*

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the lighting system. Refer to *Checking Aftermarket Accessories on page 11-871*.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Thoroughly inspect the wiring and connectors. An incomplete inspection of the wiring and connectors may result in misdiagnosis causing part replacement with the reappearance of the malfunction. If an intermittent malfunction exists, refer to *Testing for Intermittent Conditions and Poor Connections on page 11-877*.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- *Backup Lamps Malfunction on page 4-142*
- *Courtesy Lamps Malfunction on page 4-143*
- *Dome Lamps Malfunction on page 4-145*
- *Rear Fog Lamps Malfunction on page 4-146*
- *Hazard Lamps Malfunction on page 4-148*
- *Headlamps Malfunction on page 4-150*
- *Interior Backlighting Malfunction on page 4-156*
- *Park, License, and/or Tail Lamps Malfunction on page 4-160*
- *Rear Compartment Lamp Malfunction on page 4-163*
- *Stop Lamps Malfunction on page 4-164*
- *Turn Signal Lamps and/or Indicators Malfunction on page 4-167*

Backup Lamps Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F6DA (BCM 6) Fuse B+	B2545 01, B2545 04, B2615 02	B2545 01, B2545 04, B2615 02	—	—
Backup Lamps Control	B2545 02	B2545 01, B2545 04	B2545 01	—
Backup Lamp Ground – Left	—	1	—	—
Backup Lamp Ground – Right	—	1	—	—
1. Backup Lamps Malfunction				

Circuit/System Description

With the engine running and the transmission in the reverse position, the transmission control module (TCM) sends a serial data message to the body control module (BCM). The message indicates that the gear selector is in the reverse position. The BCM applies battery voltage to the backup lamps control circuit illuminating the backup lamps. Once the driver moves the gear selector out of the reverse position, a message is sent by the TCM via serial data requesting the BCM to remove battery voltage from the backup lamps control circuit. The engine must be running for the backup lamps to operate.

Diagnostic Aids

When testing at the backup lamp bulb socket, make sure all measurements and test lamp connections are in the correct terminal location and do not come in contact with each other during testing.

Reference Information

Schematic Reference

- *Exterior Lights Schematics on page 4-70*
- *Body Control System Schematics on page 11-14*

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

2.1. Vehicle OFF.

2.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If the test lamp illuminates**

3. Vehicle OFF, connect the X5 harness connector at the K9 Body Control Module.

4. Vehicle OFF, exterior lamps OFF, remove the appropriate E5 Backup Lamp bulb at the appropriate E42 Tail Lamp Assembly. It may take up to 2 minutes for all vehicle systems to power down.
5. Test for less than 5 Ω between the ground circuit at the socket terminal and ground.

⇒ **If 5 Ω or greater**

5.1. Vehicle OFF.

5.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

6. Connect a test lamp between the control circuit at the socket terminal and ground, vehicle in Service Mode.
7. Verify the test lamp turns ON and OFF when commanding the Backup Lamps ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

7.1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.

7.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

7.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

7.1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.

7.2. Test for less than 1 V between the control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

8. Test or replace the appropriate E5 Backup Lamp.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Stop and Tail Lamp Bulb Replacement (North America) on page 4-196* or *Stop and Tail Lamp Bulb Replacement (Europe, Korea) on page 4-197*
- *Tail and Turn Signal Lamp Bulb Replacement (North America) on page 4-193* or *Tail and Turn Signal Lamp Bulb Replacement (Europe, Korea) on page 4-194*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

Courtesy Lamps Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F6DA (BCM 6) Fuse B+	B2545 01, B2545 04, B2615 02	B2545 01, B2545 04, B2615 02	—	—
Dome Lamp Control	B2615 02	2	2	—
Reading Lamp Control	B1480 02	1	1	—

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Dome Lamp Ground	—	1, 2	—	—
1. Courtesy Lamps Malfunction 2. Dome Lamps Malfunction				

Circuit/System Description

The body control module (BCM) supplies battery voltage to the reading lamp via the courtesy lamp control circuit. The reading lamp is controlled by an individual switch that is activated by the operator when additional cabin lighting is required. In the event that the courtesy reading lamp were to remain illuminated for more than 10 minutes with the vehicle ON/OFF switch in the OFF position and no doors opened, the BCM will deactivate the courtesy lamp control circuit to prevent total battery discharge.

Reference Information

Schematic Reference

- *Interior Lights Schematics on page 4-74*
- *Body Control System Schematics on page 11-14*

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Interior Lighting Systems Description and Operation on page 4-200

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, all doors closed, all accessories OFF, disconnect the harness connector at the E36AH Dome Lamp. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the appropriate ground circuit terminal listed below and ground.
   - E36AH Dome Lamp – terminal 1 with UE1
   - E36AH Dome Lamp – terminal 2 without UE1

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
   - E36AH Dome Lamp – terminal 3 with UE1
   - E36AH Dome Lamp – terminal 4 without UE1
4. Verify the test lamp turns ON and OFF when commanding the Inadvertent Load ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

4.1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

5. Test or replace the E36AH Dome Lamp.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Center Courtesy Lamp Bulb Replacement on page 4-177*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

Dome Lamps Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F6DA (BCM 6) Fuse B+	B2545 01, B2545 04, B2615 02	B2545 01, B2545 04, B2615 02	—	—
Dome Lamp Control	B2615 02	2	2	—
Reading Lamp Control	B1480 02	1	1	—
Dome Lamp Ground	—	1, 2	—	—
1. Courtesy Lamps Malfunction 2. Dome Lamps Malfunction				

Circuit/System Description

When any door is opened, the door ajar switch contacts close and the body control module (BCM) receives a door-open input. The BCM illuminates the dome lamp when any door is opened or a door lock/unlock request is activated with the key fob. After all doors have been closed, the dome lamp will remain illuminated approximately 3 seconds after the last door closes. In the event that the dome lamp were to remain illuminated for more than 10 minutes with the vehicle ON/OFF switch in the OFF position and no doors opened, the BCM will deactivate the dome lamp control circuit to prevent total battery discharge.

Reference Information

Schematic Reference

- *Interior Lights Schematics on page 4-74*
- *Body Control System Schematics on page 11-14*

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Interior Lighting Systems Description and Operation on page 4-200

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Door Ajar Sw. parameter changes between Active and Inactive while opening and closing each vehicle door.

⇒ **If the parameter does not change**

Refer to *Door Ajar Indicator Malfunction on page 4-240*.

⇓ **If the parameter changes**

3. Verify the dome lamps turn ON and OFF while commanding the Courtesy Lamps ON and OFF with a scan tool.

⇒ **If the dome lamps do not turn ON and OFF**

Refer to Circuit/System Testing.

⇓ **If the dome lamps turn ON and OFF**

4. All OK.

Circuit/System Testing

1. Vehicle OFF, all doors closed, all accessories OFF, disconnect the harness connector at the E36AH Dome Lamp. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the appropriate ground circuit terminal listed below and ground.
   - E36AH Dome Lamp – terminal 1 with UE1
   - E36AH Dome Lamp – terminal 2 without UE1

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
   - E36AH Dome Lamp – terminal 2 with UE1
   - E36AH Dome Lamp – terminal 3 without UE1
4. Verify the test lamp turns ON and OFF when commanding the Courtesy Lamps ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

4.1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

5. Test or replace the E36AH Dome Lamp.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Center Courtesy Lamp Bulb Replacement on page 4-177*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

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Rear Fog Lamps Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Rear Fog Lamp Switch Signal	B3588 00	2	2	—
Rear Fog Lamps Control	B2540 02	B2540 04	1	—
Rear Fog Lamp Ground	—	1	—	—
Turn Signal/Multifunction Switch Ground	—	2	—	—
1. Rear Fog Lamp Malfunction 2. Rear Fog Lamp Switch Malfunction				

Circuit/System Description

The rear fog lamp switch signal circuit is grounded momentarily by pressing the rear fog lamp switch. The body control module (BCM) responds to the rear fog lamp request by applying voltage to the rear fog lamp control circuit which illuminates the rear fog lamp.

Reference Information

Schematic Reference

Fog Lights Schematics on page 4-69

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode, headlamps ON.
2. Verify the scan tool Rear Fog Lamps Switch parameter changes between Active and Inactive while commanding the rear fog lamp ON and OFF with the rear fog lamp switch.

⇒ **If the parameter does not change**

Refer to Rear Fog Lamp Switch Malfunction.

⇓ **If the parameter changes**

3. Verify the rear fog lamp turns ON and OFF when commanding the Rear Fog Lamps ON and OFF with a scan tool.

⇒ **If the rear fog lamp does not turn ON and OFF**

Refer to Rear Fog Lamp Malfunction.

⇓ **If the rear fog lamp turns ON and OFF**

4. Verify the rear fog lamp indicator on the instrument cluster turns ON and OFF while commanding the rear fog lamp ON and OFF with the rear fog lamp switch.

⇒ **If the rear fog lamp indicator does not turn ON and OFF**

Refer to Rear Fog Lamp Indicator Malfunction.

⇓ **If the rear fog lamp indicator turns ON and OFF**

5. All OK.

Circuit/System Testing

Rear Fog Lamp Switch Malfunction

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/ Multifunction Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 15 Ω between the ground circuit terminal 1 and ground.

⇒ **If 15 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 15 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Rear Fog Lamp Switch parameter is Inactive.

⇒ **If not Inactive**

4.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit terminal 9 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 9 and the ground circuit terminal 1.
6. Verify the scan tool Rear Fog Lamp Switch parameter is Active.

⇒ **If not Active**

6.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit terminal 9 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

7. Test or replace the S78 Turn Signal/Multifunction Switch.

Rear Fog Lamp Malfunction

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the appropriate E29 Fog Lamp at the appropriate E42 Tail Lamp Assembly.
2. Test for less than 5 Ω between the ground circuit terminal A and ground.

⇒ **If 5 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

3. Connect a test lamp between the control circuit terminal B and ground, vehicle in Service Mode.

4. Verify the test lamp turns ON and OFF when commanding the Rear Fog Lamp ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

4.1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

5. Test or replace the appropriate E29 Fog Lamp.

Rear Fog Lamp Indicator Malfunction

1. Vehicle in Service Mode.
2. Verify the rear fog lamp indicator turns ON and OFF when commanding the Instrument Cluster All Indicators Test ON and OFF with a scan tool.

⇒ **If the rear fog lamp indicator is always OFF or remains ON**

Replace the P16 Instrument Cluster.

⇓ **If the rear fog lamp indicator turns ON and OFF**

3. Replace the K9 Body Control Module.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Tail Lamp Replacement on page 4-192*
- *Turn Signal Switch Replacement on page 14-31*
- *Control Module References on page 6-3* for BCM and Instrument Cluster replacement, programming, and setup

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Hazard Lamps Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Hazard Warning Switch Signal	1	1	1	B3596 00
Hazard Warning Switch LED Backlighting Control	B2652 02	2	2	—
Hazard Warning Switch Ground	—	1	—	—
1. Hazard Lamps Malfunction 2. Hazard Warning Switch Backlighting Malfunction				

Circuit/System Description

The hazard flashers may be activated in any power mode. The hazard warning switch signal circuit is momentarily grounded when the hazard warning switch is pressed. The body control module (BCM) responds to the hazard warning switch signal input by supplying battery voltage to all four turn signal lamps in an ON and OFF duty cycle. When the hazard warning switch is activated, the BCM sends a serial data message to the instrument cluster requesting both turn signal indicators to be cycled ON and OFF.

The instrument panel dimmer switch controls are located on the headlamp switch assembly and are used to increase and decrease the brightness of the interior backlighting components. When the instrument panel dimmer switch is placed in a desired brightness position, the body control module (BCM) receives a

signal from the instrument dimmer switch and responds by applying a pulse width modulated (PWM) voltage to the hazard switch LED backlighting control circuit illuminating the LED to the desired level of brightness.

Reference Information

Schematic Reference

Exterior Lights Schematics on page 4-70

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Hazard Lamps Switch parameter changes between Active and Inactive while commanding the hazard lamps ON and OFF with the hazard warning switch.

⇒ **If the parameter does not change**

Refer to Hazard Warning Switch Malfunction.

⇓ **If the parameter changes**

3. Verify all left and right turn signal lamps turn ON and OFF while commanding the hazard lamps ON and OFF with the hazard warning switch.

⇒ **If all turn signal lamps do not turn ON and OFF**

Refer to *Turn Signal Lamps and/or Indicators Malfunction on page 4-167*

⇓ **If all turn signal lamps turn ON and OFF**

4. Verify the hazard warning switch backlighting turns ON and OFF while commanding the Hazard Lamps Switch Backlight ON and OFF with a scan tool.

⇒ **If the hazard warning switch backlighting does not turn ON and OFF**

Refer to Hazard Warning Switch Backlighting Malfunction.

⇓ **If the hazard warning switch backlighting turns ON and OFF**

5. All OK.

Circuit/System Testing

Hazard Warning Switch Malfunction

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S26 Hazard Warning Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 8 and ground.

⇒ **If 5 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Hazard Lamps Switch parameter is Inactive.

⇒ **If not Inactive**

4.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit terminal 7 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 7 and ground.
6. Verify the scan tool Hazard Lamps Switch parameter is Active.

⇒ **If not Active**

6.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

7. Test or replace the S26 Hazard Warning Switch.

Hazard Warning Switch Backlighting Malfunction

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S26 Hazard Warning Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 3 and ground.

⇒ **If 5 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

3. Connect a test lamp between the control circuit terminal 2 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the Hazard Lamps Switch Backlight ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

4.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

5. Test or replace the S26 Hazard Warning Switch.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Hazard Warning Switch Replacement on page 4-173*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

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Headlamps Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F3DA (BCM 3) Fuse B+	B2699 01, B2699 04	B2699 01, B2699 04	—	—
F4DA (BCM 4) Fuse B+	B2575 01, B2575 04	B2575 01, B2575 04	—	—
Headlamp High Beam Relay Control	B2580 02	B2580 04	B2580 01	—

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Low Beam Headlamp Control – Left	B2575 02	B2575 01, B2575 04	B2575 04	—
Low Beam Headlamp Control – Right	B2699 02	B2699 01, B2699 04	B2699 04	—
High Beam Headlamp Control – Left	2	2	2	—
High Beam Headlamp Control – Right	2	2	2	—
Headlamp Switch Headlamps ON Signal	B257A 00	3	3	—
Turn Signal/Multifunction Switch Flash To Pass Signal	B3806 00	4	4	—
Turn Signal/Multifunction Switch High Beam Signal	B3650 08	4	4	—
Headlamp Ground – Left	—	1	—	—
Headlamp Ground – Right	—	1	—	—
Headlamp Switch Ground	—	3	—	—
Turn Signal/Multifunction Switch Ground	—	4	—	—

1. Headlamps Malfunction – Low Beam
2. Headlamps Malfunction – High Beam
3. Headlamp Switch Malfunction
4. Turn Signal/Multifunction Switch Malfunction

Circuit/System Description

The body control module (BCM) monitors two signal circuits from the headlamp switch. With the headlamp switch in the PARK position, the headlamp switch park lamps ON signal circuit is grounded, indicating that the park lamps have been requested. When the headlamp switch is placed in the HEADLAMP position, both the headlamp switch park lamps ON signal circuit and the headlamp switch headlamps ON signal circuit are grounded. The BCM responds to the inputs by illuminating the park lamps and headlamps. When the low beam headlamps are requested, the BCM applies B+ to both low beam headlamp control circuits illuminating the low beam headlamps.

The high beam and flash to pass functions are contained within the turn signal/multifunction switch. The BCM provides the turn signal/multifunction switch with two signal circuits, the high beam signal circuit and the flash to pass signal circuit. When the low beam headlamps are ON and the turn signal/multifunction switch is placed in the high beam position, ground is applied to the BCM through the high beam signal circuit. The BCM responds to the high beam request by applying ground to the high beam relay control circuit which energizes the high beam relay. With the high beam relay energized, the switch contacts close allowing battery voltage to flow through the high beam fuses to the high beam control circuits illuminating the high beam headlamps.

When the turn signal/multifunction switch is momentarily placed in the flash to pass position, ground is applied to the BCM through the flash to pass signal circuit. The BCM responds by applying ground to the high beam relay control circuit which energizes the high beam relay illuminating the high beams for a brief moment or until the flash to pass switch is released.

Reference Information

Schematic Reference

- *Headlights/Daytime Running Lights (DRL) Schematics on page 4-67*
- *Body Control System Schematics on page 11-14*

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Headlamps On Switch parameter changes between Active and Inactive while commanding the headlamp ON and OFF with the headlamp switch.

⇒ **If the parameter does not change**

Refer to Headlamp Switch Malfunction.

⇓ **If the parameter changes**

3. Verify the scan tool Headlamps Flash Switch parameter changes between Active and Inactive while commanding the flash to pass ON and OFF with the turn signal/multifunction switch.

⇒ **If the parameter does not change**

Refer to Turn Signal/Multifunction Switch Malfunction.

⇓ **If the parameter changes**

4. Verify the scan tool High Beam Select Switch parameter changes between Active and Inactive while commanding the high beams ON and OFF with the turn signal/multifunction switch.

⇒ **If the parameter does not change**

Refer to Turn Signal/Multifunction Switch Malfunction.

⇓ **If the parameter changes**

5. Verify the left low beam turns ON and OFF when commanding the Left Low Beam/Daytime Running Lamp ON and OFF with a scan tool.

⇒ **If the left low beam does not turn ON and OFF**

Refer to Headlamps Malfunction – Low Beam.

⇓ **If the left low beam turns ON and OFF**

6. Verify the right low beam turns ON and OFF when commanding the Right Low Beam/Daytime Running Lamp ON and OFF with a scan tool.

⇒ **If the right low beam does not turn ON and OFF**

Refer to Headlamps Malfunction – Low Beam.

⇓ **If the right low beam turns ON and OFF**

7. Verify the high beams turn ON and OFF when commanding the High Beams ON and OFF with a scan tool.

⇒ **If the high beams do not turn ON and OFF**

Refer to Headlamps Malfunction – High Beam.

⇓ **If the high beams turn ON and OFF**

8. Verify the high beam indicator on the instrument cluster turns ON and OFF while commanding the All Indicators Test ON and OFF with a scan tool.

⇒ **If the high beam indicator does not turn ON and OFF**

Refer to High Beam Indicator Malfunction.

⇓ **If the high beam indicator turns ON and OFF**

9. All OK.

Circuit/System Testing

Headlamp Switch Malfunction

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/ Multifunction Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 15 Ω between the ground circuit terminal 1 and ground.

⇒ **If 15 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 15 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Park Lamps Switch parameter is Inactive.

⇒ **If not Inactive**

4.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit terminal 2 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 1.
6. Verify the scan tool Park Lamps Switch parameter is Active.

⇒ **If not Active**

6.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit terminal 2 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

7. Verify the scan tool Headlamps On Switch parameter is Inactive.

⇒ **If not Inactive**

7.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.

7.2. Test for infinite resistance between the signal circuit terminal 3 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

8. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ground circuit terminal 1.
9. Verify the scan tool Headlamps On Switch parameter is Active.

⇒ **If not Active**

9.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

9.2. Test for less than 1 V between the signal circuit terminal 3 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

9.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

10. Test or replace the S78 Turn Signal/Multifunction Switch.

Turn Signal/Multifunction Switch Malfunction

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/ Multifunction Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 15 Ω between the ground circuit terminal 1 and ground.

⇒ **If 15 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 15 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool High Beam Select Switch parameter is Inactive.

⇒ **If not Inactive**

4.1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit terminal 6 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 6 and the ground circuit terminal 1.
6. Verify the scan tool High Beam Select Switch parameter is Active.

⇒ **If not Active**

6.1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit terminal 6 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

7. Verify the scan tool Headlamps Flash Switch parameter is Inactive.

⇒ **If not Inactive**

7.1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module.

7.2. Test for infinite resistance between the signal circuit terminal 7 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

8. Install a 3 A fused jumper wire between the signal circuit terminal 7 and the ground circuit terminal 1.

9. Verify the scan tool Headlamps Flash Switch parameter is Active.

⇒ **If not Active**

9.1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle in Service Mode.

9.2. Test for less than 1 V between the signal circuit terminal 7 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

9.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

10. Test or replace the S78 Turn Signal/Multifunction Switch.

Headlamps Malfunction – Low Beam

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the appropriate E13 Headlamp. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the appropriate ground circuit terminal listed below and ground.
   - Terminal 1 – without EF7/Z49
   - Terminal B – with EF7/Z49

⇒ **If 5 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

3. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
   - Terminal 2 – without EF7/Z49 (left)
   - Terminal A – with EF7/Z49 (left)
   - Terminal 3 – without EF7/Z49 (right)
   - Terminal C – with EF7/Z49 (right)
4. Verify the test lamp turns ON and OFF when commanding the appropriate Low Beam/Daytime Running Lamp ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

4.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

5. Test or replace the appropriate E4 Headlamp – low beam.

Headlamps Malfunction – High Beam

1. Vehicle OFF, remove the KR48 Headlamp High Beam Relay, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 85 and ground.

⇒ **If the test lamp does not illuminate**

Replace the X50A Fuse Block – Underhood.

⇓ **If the test lamp illuminates**

3. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.

⇒ **If the test lamp does not illuminate**

Replace the X50A Fuse Block – Underhood.

⇓ **If the test lamp illuminates**

4. Vehicle OFF, connect a test lamp between the control circuit terminal 86 and B+, vehicle in Service Mode.

5. Verify the test lamp turns ON and OFF when commanding the High Beams ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

5.1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.

5.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

5.3. Vehicle OFF.

5.4. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

5.1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module.

5.2. Test for infinite resistance between the control circuit terminal and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

6. Vehicle OFF, exterior lamps OFF, connect the KR48 Headlamp High Beam Relay.
7. Disconnect the harness connector at the appropriate E13 Headlamp. It may take up to 2 min for all vehicle systems to power down.
8. Test for less than 5 Ω between the appropriate ground circuit terminal listed below and ground.
   - Terminal 1 – without EF7/Z49
   - Terminal B – with EF7/Z49

⇒ **If 5 Ω or greater**

8.1. Vehicle OFF.

8.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

9. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
   - Terminal 3 – without EF7/Z49 (left)
   - Terminal C – with EF7/Z49 (left)
   - Terminal 2 – without EF7/Z49 (right)
   - Terminal A – with EF7/Z49 (right)
10. Verify the test lamp turns ON and OFF when commanding the High Beams ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

10.1. Vehicle OFF, disconnect the X1 harness connector at the X50A Fuse Block – Underhood.

10.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

10.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the KR48 Headlamp High Beam Relay.

⇒ **If the test lamp is always ON**

10.1. Vehicle OFF, disconnect the X1 harness connector at the X50A Fuse Block – Underhood, vehicle in Service Mode.

10.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the KR48 Headlamp High Beam Relay.

⇓ **If the test lamp turns ON and OFF**

11. Test or replace the appropriate E4 Headlamp – high beam.

High Beam Indicator Malfunction

1. Vehicle in Service Mode.
2. Verify the high beam indicator turns ON and OFF when commanding the Instrument Cluster All Indicators Test ON and OFF with a scan tool.

⇒ **If the high beam indicator is always OFF or remains ON**

Replace the P16 Instrument Cluster.

⇓ **If the high beam indicator turns ON and OFF**

3. Replace the K9 Body Control Module.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Headlamp Bulb Replacement (North America) on page 4-179* or *Headlamp Bulb Replacement (Europe, Korea) on page 4-180*
- *Relay Replacement (Within an Electrical Center) on page 11-953* or *Relay Replacement (Attached to Wire Harness) on page 11-953*
- *Turn Signal Switch Replacement on page 14-31*
- *Control Module References on page 6-3* for BCM or Instrument Cluster replacement, programming, and setup

Interior Backlighting Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F1DA (BCM 1) Fuse B+	B101E 43, B1395 03, B1517 07, C0890 03, U0121 00,	B101E 43, B1395 03, B1517 07, C0890 03, U0121 00,	—	—
Instrument Panel Dimmer Switch B+	B1395 03, B3600 03	B3600 03	B1395 07	—
Instrument Panel Dimmer Switch Signal	B1395 03, B3600 03	B3600 03	B3600 07	—
Hazard Warning Switch LED Backlight Dimming Control	B2652 02	1	1	—
LED Backlight Dimming Control Terminal 8 X2	B2610 02	B2610 04	B2610 01	—
Instrument Panel Dimmer Switch Low Reference	2	2	2	—
Door Lock Switch – Driver Ground	—	1	—	—
Door Lock Switch – Passenger Ground	—	1	—	—
Drive Mode Select Switch Ground	—	1	—	—
Hazard Warning Switch Ground	—	3	—	—
Instrument Panel Dimmer Switch Ground	—	1	—	—
Multifunction Switch – Center Console Ground	—	1	—	—
Park Break Control Switch Ground	—	1	—	—
Seat Heating Switch – Driver Ground	—	1	—	—
Seat Heating Switch – Passenger Ground	—	1	—	—
Steering Wheel Controls Switch – Left Ground	—	1	—	—
Steering Wheel Controls Switch – Right Ground	—	1	—	—
Transmission Shift Lever Ground	—	1	—	—

1. Interior Backlighting Malfunction
2. Dimmer Switch Malfunction
3. Hazard Warning Switch Backlighting Malfunction

Circuit/System Description

The instrument panel dimmer switch is used to increase and decrease the brightness of the interior backlighting components. The instrument panel dimmer switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides a low reference, signal, and B+ voltage circuits to the instrument panel dimmer switch. When the instrument panel dimmer switch is placed in the desired position, the dimmed voltage setting is applied from the instrument panel dimmer switch through the instrument panel dimmer switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated (PWM) voltage through the light emitting diode (LED) dimming control circuits illuminating the interior backlighting to the requested level of brightness.

Reference Information

Schematic Reference

Interior Lights Dimming Schematics on page 4-76

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Interior Lighting Systems Description and Operation on page 4-200

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool LED Backlight Dimming Command parameter changes between a high percentage to a low percentage while operating the dimmer switch from high to low.

⇒ **If the parameter does not change**

Refer to Dimmer Switch Malfunction.

⇓ **If the parameter changes**

3. Verify the backlighting components turn ON and OFF while commanding the LED Backlight Dimming ON and OFF with a scan tool.

⇒ **If the backlighting components do not turn ON and OFF**

Refer to Interior Backlighting Malfunction.

⇓ **If the backlighting components turn ON and OFF**

4. Verify the hazard warning switch backlighting turns ON and OFF while commanding the Hazard Lamps Switch Backlight ON and OFF with a scan tool.

⇒ **If the hazard warning switch backlighting does not turn ON and OFF**

Refer to Hazard Warning Switch Backlighting Malfunction.

⇓ **If the hazard warning switch backlighting turns ON and OFF**

5. All OK.

Circuit/System Testing

Dimmer Switch Malfunction

1. Vehicle OFF, disconnect the harness connector at the S36 Instrument Panel Dimmer Switch, vehicle in Service Mode.
2. Verify a test lamp illuminates between the low reference circuit terminal 12 and B+.

⇒ **If the test lamp does not illuminate**

2.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

2.2. Test for less than 1 V between the low reference circuit terminal 12 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

2.3. Test for less than 2 Ω in the low reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If the test lamp illuminates**

3. Test for B+ between the B+ reference circuit terminal 11 and ground.

⇒ **If less than B+**

3.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.

3.2. Test for infinite resistance between the B+ reference circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

3.3. Test for less than 2 Ω in the B+ reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If B+**

4. Verify a test lamp does not illuminate between the B+ reference circuit terminal 11 and ground.

⇒ **If the test lamp illuminates**

4.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the B+ reference circuit terminal 11 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp does not illuminate**

5. Park lamps ON, verify a test lamp does not illuminate between the signal circuit terminal 10 and ground.

⇒ **If the test lamp illuminates**

5.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.

5.2. Test for less than 1 V between the signal circuit terminal 10 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp does not illuminate**

6. Vehicle in Service Mode, park lamps OFF, test for between 57.4 K ohms and 58 K ohms between the signal circuit terminal 10 and ground.

⇒ **If not between 57.4 K ohms and 58 K ohms**

6.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.

6.2. Test for infinite resistance between the signal circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If between 57.4 K ohms and 58 K ohms**

7. Test or replace the S36 Instrument Panel Dimmer Switch.

Interior Backlighting Malfunction

Note: Each component with backlighting may need to be disconnected to isolate a short to voltage or short to ground. Use the schematics to identify the following:

- Backlighting components the vehicle is equipped with
- Each component's control and ground circuit terminals
- Component locations on the backlighting control circuit

1. Vehicle OFF, all doors closed, all accessories OFF, disconnect the harness connector at the component with inoperative backlighting. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 15 Ω between the appropriate ground circuit terminal listed below and ground.
   - S13D Door Lock Switch – Driver terminal 3
   - S13P Door Lock Switch – Passenger terminal 3
   - S126 Drive Mode Select Switch terminal 4
   - S36 Instrument Panel Dimmer Switch terminal 4
   - S48E Multifunction Switch – Center Console terminal 9
   - S91 Park Brake Control Switch terminal 8
   - S32D Seat Heating Switch – Driver terminal 5
   - S32P Seat Heating Switch – Passenger terminal 5
   - S70L Steering Wheel Controls Switch – Left terminal 2
   - S70R Steering Wheel Controls Switch – Right terminal 2
   - S3 Transmission Shift Lever terminal 3

⇒ **If 15 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 15 Ω**

3. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
   - S13D Door Lock Switch – Driver terminal 1
   - S13P Door Lock Switch – Passenger terminal 1
   - S126 Drive Mode Select Switch terminal 3
   - S36 Instrument Panel Dimmer Switch terminal 3
   - S48E Multifunction Switch – Center Console terminal 10
   - S91 Park Brake Control Switch terminal 6
   - S32D Seat Heating Switch – Driver terminal 6
   - S32P Seat Heating Switch – Passenger terminal 6
   - S70L Steering Wheel Controls Switch – Left terminal 1
   - S70R Steering Wheel Controls Switch – Right terminal 1
   - S3 Transmission Shift Lever terminal 1
4. Verify the test lamp turns ON and OFF when commanding the LED Backlight Dimming ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

4.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

5. Test or replace the component with inoperative backlighting.

Hazard Warning Switch Backlighting Malfunction

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S26 Hazard Warning Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 3 and ground.

⇒ **If 5 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

3. Connect a test lamp between the control circuit terminal 2 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the Hazard Lamps Switch Backlight ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

4.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

5. Test or replace the S26 Hazard Warning Switch.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Hazard Warning Switch Replacement on page 4-173*
- *Door Lock Switch Replacement on page 4-281*
- *Cruise Control Switch Replacement on page 9-47*
- *Radio Control Switch Replacement on page 8-63*
- *Front Seat Heater Switch Replacement on page 13-31*
- *Parking Brake Actuator Switch Replacement on page 5-265*
- *Fuel Economy Switch Replacement on page 8-98*
- *Control Module References on page 6-3* for BCM or HVAC control module replacement, programming, and setup

Park, License, and/or Tail Lamps Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F5DA (BCM 5) Fuse B+	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	—	—
Headlamp Switch Park Lamps ON Signal	2	B257A 00	2	—
License Plate Lamp Control	B3883 02	B3883 01, B3883 04	B3883 01, B3883 04	—
Front Park and Rear Tail Lamp Control - Left	B2585 02	B2585 01, B2585 04	B2585 01, B2585 04	—
Front Park and Rear Tail Lamp Control - Right	B3867 02	B3867 01, B3867 04	B3867 01, B3867 04	—
License Plate Lamp Ground	—	1	—	—
Park Lamp Ground - Left Front	—	1	—	—
Park Lamp Ground - Right Front	—	1	—	—
Rear Tail/Stop Lamps Ground - Left	—	1	—	—
Rear Tail/Stop Lamps Ground - Right	—	1	—	—
Turn Signal/Multifunction Switch Ground	—	2	—	—
1. Park, License, and/or Tail Lamps Malfunction 2. Park Lamp Switch Malfunction				

Circuit/System Description

When the headlamp switch is placed in the HEAD or PARK position, ground is applied to the park lamp switch ON signal circuit to the body control module (BCM). The BCM responds by applying voltage to the park lamps, tail lamps, and license lamps control circuits illuminating the park, tail, and license lamps.

Diagnostic Aids

When testing at the park lamp bulb sockets, make sure all measurements and test lamp connections are in the correct terminal location and do not come in contact with each other during testing.

Reference Information

Schematic Reference

Exterior Lights Schematics on page 4-70

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Park Lamp Switch parameter changes between Active and Inactive while commanding the park lamps ON and OFF with the headlamp switch.

⇒ **If the parameter does not change**

Refer to Park Lamp Switch Malfunction.

⇓ **If the parameter changes**

3. Verify the left park lamps turn ON and OFF when commanding the Left Park Lamps ON and OFF with a scan tool.

⇒ **If the left park lamps do not turn ON and OFF**

Refer to Park Lamps Malfunction.

⇓ **If the left park lamps turn ON and OFF**

4. Verify the right park lamps turn ON and OFF when commanding the Right Park Lamps ON and OFF with a scan tool.

⇒ **If the right park lamps do not turn ON and OFF**

Refer to Park Lamps Malfunction.

⇓ **If the right park lamps turn ON and OFF**

5. Verify the license plate lamp turns ON and OFF when commanding the License Plate Lamps ON and OFF with a scan tool.

⇒ **If the license plate lamp does not turn ON and OFF**

Refer to License Plate Lamp Malfunction.

⇓ **If the license plate lamp turns ON and OFF**

6. All OK.

Circuit/System Testing

Park Lamp Switch Malfunction

1. Vehicle OFF, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/Multifunction Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 15 Ω between the ground circuit terminal 1 and ground.

⇒ **If 15 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 15 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Park Lamps Switch parameter is Inactive.

⇒ **If not Inactive**

4.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit terminal 2 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 1.
6. Verify the scan tool Park Lamps Switch parameter is Active.

⇒ **If not Active**

6.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

7. Test or replace the S78 Turn Signal/Multifunction Switch.

Park Lamps Malfunction

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the appropriate park lamp. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the appropriate ground circuit terminal listed below and ground.
   - E4N Park/Turn Signal Lamp - Left socket terminal C
   - E4P Park/Turn Signal Lamp - Right socket terminal C
   - E5AA Tail/Stop Lamp - Left socket terminal 2
   - E5AB Tail/Stop Lamp - Right socket terminal 2
   - E5AC Tail/Turn Signal Lamp - Left socket terminal G
   - E5AD Tail/Turn Signal Lamp - Right socket terminal G

⇒ **If 5 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

3. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
   - E4N Park/Turn Signal Lamp - Left socket terminal B
   - E4P Park/Turn Signal Lamp - Right socket terminal B
   - E5AA Tail/Stop Lamp - Left socket terminal 3
   - E5AB Tail/Stop Lamp - Right socket terminal 3
   - E5AC Tail/Turn Signal Lamp - Left socket terminal B
   - E5AD Tail/Turn Signal Lamp - Right socket terminal B
4. Verify the test lamp turns ON and OFF when commanding the appropriate Park Lamps ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

4.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

5. Test or replace the appropriate park lamp.

License Plate Lamp Malfunction

1. Vehicle OFF, exterior lamps OFF, remove the E7 License Plate Lamp Bulb. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between each ground circuit terminal 1 and ground.

⇒ **If 5 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

3. Connect a test lamp between the control circuit terminal 2 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the License Plate Lamps ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

4.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

5. Test or replace the E7 License Plate Lamp Bulb.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Rear License Plate Lamp Replacement on page 4-191*
- *Front Turn Signal Lamp Bulb Replacement (North America) on page 4-187* or *Front Turn Signal Lamp Bulb Replacement (Europe, Korea) on page 4-188*
- *Tail and Turn Signal Lamp Bulb Replacement (North America) on page 4-193* or *Tail and Turn Signal Lamp Bulb Replacement (Europe, Korea) on page 4-194*
- *Turn Signal Switch Replacement on page 14-31*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

Rear Compartment Lamp Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Rear Compartment Courtesy Lamp Control	B2570 02	1	1	—
Rear Compartment Courtesy Lamp Ground	—	1	—	—
1. Rear Compartment Lamp Malfunction				

Circuit/System Description

The body control module (BCM) applies battery voltage to the rear compartment courtesy lamp through the rear compartment lamp control circuit. When the BCM receives a rear compartment lid open input from the rear compartment lid latch, the BCM applies battery voltage to the rear compartment lamp control circuit illuminating the rear compartment courtesy lamp. In the event that the rear compartment lamp were to remain illuminated for more than 10 minutes with the vehicle ON/OFF switch in the OFF position and no doors opened, the BCM will deactivate the rear compartment lamp control circuit to prevent total battery discharge.

Reference Information

Schematic Reference

Interior Lights Schematics on page 4-74

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Interior Lighting Systems Description and Operation on page 4-200

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E8S Rear Compartment Courtesy Lamp. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 2 and ground.

⇒ **If 5 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

3. Connect a test lamp between the control circuit terminal 1 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the Cargo Lamp ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

4.1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

5. Test or replace the E8S Rear Compartment Courtesy Lamp.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Rear Compartment Courtesy Lamp Replacement on page 4-198*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

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Stop Lamps Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Pedal Position Sensor 5 V Reference	C0277 06, C0890 03, C0161 71	C0277 06, C0161 71	C0890 07, C0161 71	—
Brake Pedal Position Sensor Signal	C0277 06, C0161 71	C0277 06, C0161 71	C0277 07, C0161 71	C0277 09
Center High Mounted Stop Lamp Control	B3884 02	2	2	—
Stop Lamp Control – Left	B3881 02	B3881 04	B3881 01	—
Stop Lamp Control – Right	B3882 02	B3882 04	B3882 01	—
Brake Pedal Position Sensor Low Reference	—	C0277 07, C0161 71	1	—
Center High Mounted Stop Lamp Ground	—	2	—	—
Rear Tail/Stop Lamp Ground – Left	—	1	—	—
Rear Tail/Stop Lamp Ground – Right	—	1	—	—
1. Stop Lamps Malfunction 2. Center High Mounted Stop Lamp Malfunction				

Circuit/System Description

The brake pedal position (BPP) sensor is used to sense the action of the driver application of the brake pedal. The BPP sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5-volt reference voltage to the BPP sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the left and right stop lamp control circuits as well as the center high mounted stop lamp (CHMSL) control circuit illuminating the left and right stop lamps and the CHMSL.

Diagnostic Aids

When testing at the stop lamp bulb socket, make sure all measurements and test lamp connections are in the correct terminal location and do not come in contact with each other during testing.

Reference Information

Schematic Reference

Exterior Lights Schematics on page 4-70

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Brake Lamps Command parameter changes between Active and Inactive while pressing and releasing the brake pedal.

⇒ **If the parameter does not change**

Refer to Brake Pedal Position Sensor Malfunction.

⇓ **If the parameter changes**

3. Verify the left brake lamp turns ON and OFF when commanding the Left Brake Lamp ON and OFF with a scan tool.

⇒ **If the left brake lamp does not turn ON and OFF**

Refer to Stop Lamps Malfunction.

⇓ **If the left brake lamp turns ON and OFF**

4. Verify the right brake lamp turns ON and OFF when commanding the Right Brake Lamp ON and OFF with a scan tool.

⇒ **If the right brake lamp does not turn ON and OFF**

Refer to Stop Lamps Malfunction.

⇓ **If the right brake lamp turns ON and OFF**

5. Verify the center high mounted stop lamp turns ON and OFF when commanding the Center Brake Lamp ON and OFF with a scan tool.

⇒ **If the center high mounted stop does not turn ON and OFF**

Refer to Center High Mount Stop Lamp Malfunction.

⇓ **If the center high mounted stop turns ON and OFF**

6. All OK.

Circuit/System Testing

Brake Pedal Position Sensor Malfunction

1. Vehicle OFF, disconnect the harness connector at the B22 Brake Pedal Position Sensor, vehicle in Service Mode.
2. Test for less than 1 V between the low reference circuit terminal A and ground.

⇒ **If 1 V or greater**

2.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

2.2. Test for less than 1 V between the low reference circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If less than 1 V**

3. Test or replace the B22 Brake Pedal Position Sensor.

Stop Lamps Malfunction

1. Vehicle OFF, exterior lamps OFF, remove the appropriate E5A Tail/Stop Lamp Bulb. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit at the socket terminal and ground.

⇒ **If 5 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

3. Connect a test lamp between the control circuit at the socket terminal and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the appropriate Brake Lamp ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module.

- X4 left stop lamp
- X5 right stop lamp

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

4.1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module, vehicle in Service Mode.
- X4 left stop lamp
- X5 right stop lamp

4.1. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

5. Test or replace the appropriate E5A Tail/Stop Lamp Bulb.

Center High Mount Stop Lamp Malfunction

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E6 Center High Mounted Stop Lamp. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 2 and ground.

⇒ **If 5 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

3. Connect a test lamp between the control circuit terminal 1 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the Center Brake Lamp ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

4.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.

4.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

5. Test or replace the E6 Center High Mounted Stop Lamp.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *High Mount Stop Lamp Replacement on page 4-189*
- *Stop and Tail Lamp Bulb Replacement (North America) on page 4-196* or *Stop and Tail Lamp Bulb Replacement (Europe, Korea) on page 4-197*
- *Tail and Turn Signal Lamp Bulb Replacement (North America) on page 4-193* or *Tail and Turn Signal Lamp Bulb Replacement (Europe, Korea) on page 4-194*
- *Brake Pedal Position Sensor Replacement (Travel Sensor) on page 4-170* or *Brake Pedal Position Sensor Replacement (Apply Sensor) on page 4-171*
- *Brake Pedal Position Sensor Calibration on page 4-170*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

Turn Signal Lamps and/or Indicators Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F5DA (BCM 5) Fuse B+	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	B3867 01, B3867 04, B3881 01, B3881 04, B3949 01, B3949 04, B3950 01, B3950 04	—	—
F7DA (BCM 7) Fuse B+	B3948 01, B3948 04, B3951 01, B3951 04	B3948 01, B3948 04, B3951 01, B3951 04	—	—
Turn Signal Switch Signal – Left	2	2	2	—
Turn Signal Switch Signal – Right	2	2	2	—
Turn Signal Control – Left Front	B3948 02	B3948 01, B3948 04	B3948 01, B3948 04	—
Turn Signal Control – Left Rear	B3950 02	B3950 01, B3950 04	B3950 01, B3950 04	—
Turn Signal Control – Right Front	B3949 02	B3949 01, B3949 04	B3949 01, B3949 04	—
Turn Signal Control – Right Rear	B3951 02	B3951 01, B3951 04	B3951 01, B3951 04	—
Turn Signal Lamp Ground – Left Front	—	1	—	—
Turn Signal Lamp Ground – Right Front	—	1	—	—
Turn Signal Lamp Ground – Left Rear	—	1	—	—
Turn Signal Lamp Ground – Right Rear	—	1	—	—
Turn Signal Repeater Lamp Ground – Left – with T90	—	1	—	—
Turn Signal Repeater Lamp Ground – Right – with T90	—	1	—	—
Turn Signal/Multifunction Switch Ground	—	2	—	—
1. Turn Signal Lamps and/or Indicators Malfunction 2. Turn Signal/Multifunction Switch Malfunction				

Circuit/System Description

Ground is applied at all times to the turn signal/ multifunction switch. The turn signal lamps may only be activated with the vehicle ON/OFF switch in the Service Mode or ON positions. When the turn signal/ multifunction switch is placed in either the turn left or turn right position, ground is applied to the body control module (BCM) through either the right turn or left turn signal switch signal circuit. The BCM responds to the turn signal switch input by applying a pulsating voltage to the front and rear turn signal lamps through there respective control circuits. When a turn signal request is received by the BCM, a serial data message is sent to the instrument cluster requesting the respective turn signal indicator be pulsed ON and OFF.

Diagnostic Aids

When testing at the turn signal lamp bulb socket, make sure all measurements and test lamp connections are in the correct terminal location and do not come in contact with each other during testing.

Reference Information

Schematic Reference

- *Exterior Lights Schematics on page 4-70*
- *Body Control System Schematics on page 11-14*

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Exterior Lighting Systems Description and Operation on page 4-198

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Right Turn Signal Switch and Left Turn Signal Switch parameters change between Active and Inactive while cycling the turn signal switch between the right and left positions.

⇒ **If the parameters do not change**

Refer to Turn Signal/Multifunction Switch Malfunction.

⇓ **If the parameters change**

3. Verify the left front turn signal lamps turn ON and OFF while commanding the Left Front Turn Signal Lamp ON and OFF with a scan tool.

⇒ **If the left front turn signal lamps do not turn ON and OFF**

Refer to Turn Signal Lamps Malfunction.

⇓ **If the left front turn signal lamps turn ON and OFF**

4. Verify the right front turn signal lamps turn ON and OFF while commanding the Right Front Turn Signal Lamp ON and OFF with a scan tool.

⇒ **If the right front turn signal lamps do not turn ON and OFF**

Refer to Turn Signal Lamps Malfunction.

⇓ **If the right front turn signal lamps turn ON and OFF**

5. Verify the left rear turn signal lamps turn ON and OFF while commanding the Left Rear Turn Signal Lamp ON and OFF with a scan tool.

⇒ **If the left rear turn signal lamps do not turn ON and OFF**

Refer to Turn Signal Lamps Malfunction.

⇓ **If the left rear turn signal lamps turn ON and OFF**

6. Verify the right rear turn signal lamps turn ON and OFF while commanding the Right Rear Turn Signal Lamp ON and OFF with a scan tool.

⇒ **If the right rear turn signal lamps do not turn ON and OFF**

Refer to Turn Signal Lamps Malfunction.

⇓ **If the right rear turn signal lamps turn ON and OFF**

7. Verify the left and right turn signal indicators turn ON and OFF while commanding the All Indicators Test ON and OFF with a scan tool.

⇒ **If the left or right turn signal indictors do not turn ON and OFF**

Refer to Turn Signal Indicators Malfunction.

⇓ **If the left and right turn signal indictors turn ON and OFF**

8. All OK.

Circuit/System Testing

Turn Signal/Multifunction Switch Malfunction

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/ Multifunction Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 15 Ω between the ground circuit terminal 1 and ground.

⇒ **If 15 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 15 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Left Turn Signal Switch parameter is Inactive.

⇒ **If not Inactive**

4.1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit terminal 4 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the ground circuit terminal 1.

6. Verify the scan tool Left Turn Signal Switch parameter is Active.

⇒ **If not Active**

6.1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit terminal 4 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

7. Verify the scan tool Right Turn Signal Switch parameter is Inactive.

⇒ **If not Inactive**

7.1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module.

7.2. Test for infinite resistance between the signal circuit terminal 5 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

8. Install a 3 A fused jumper wire between the signal circuit terminal 5 and the ground circuit terminal 1.
9. Verify the scan tool Right Turn Signal Switch parameter is Active.

⇒ **If not Active**

9.1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle in Service Mode.

9.2. Test for less than 1 V between the signal circuit terminal 5 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

9.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

10. Test or replace the S78 Turn Signal/Multifunction Switch.

Turn Signal Lamps Malfunction

1. Vehicle OFF, exterior lamps OFF, remove the appropriate turn signal lamp bulb. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the appropriate ground circuit at the socket terminal and ground.

⇒ **If 5 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

3. Connect a test lamp between the appropriate control circuit at the socket terminal and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the appropriate Turn Signal Lamp ON and OFF with a scan tool.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module.

- X5 left turn signals
- X4 right turn signals

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

4.1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module, vehicle in Service Mode.

- X5 left turn signals
- X4 right turn signals

4.2. Test for less than 1 V between the control circuit terminal and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

5. Test or replace the appropriate turn signal lamp bulb.

Turn Signal Indicators Malfunction

1. Vehicle in Service Mode.
2. Verify the left and right turn signal indicators turn ON and OFF while commanding the All Indicators Test ON and OFF with a scan tool.

⇒ **If the left or right turn signal indictors are always OFF or remain ON**

Replace the P16 Instrument Cluster.

⇓ **If the left and right turn signal indictors turn ON and OFF**

3. Replace the K9 Body Control Module.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Turn Signal Switch Replacement on page 14-31*
- *Front Turn Signal Lamp Bulb Replacement (North America) on page 4-187* or *Front Turn Signal Lamp Bulb Replacement (Europe, Korea) on page 4-188*
- *Tail and Turn Signal Lamp Bulb Replacement (North America) on page 4-193* or *Tail and Turn Signal Lamp Bulb Replacement (Europe, Korea) on page 4-194*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup

Repair Instructions

Brake Pedal Position Sensor Calibration

Calibration Criteria

Note: Do not apply the brake pedal during the brake pedal position sensor calibration procedure. Any movement of the brake pedal during this procedure will cause the calibration procedure to fail. If this occurs, the brake pedal position sensor calibration must be repeated.

Brake pedal position sensor calibration must be performed after the brake pedal position sensor, body control module (BCM), engine control module (ECM), or hybrid powertrain control module have been serviced. The calibration procedure will set the brake pedal position sensor home value. This value is used by the BCM and ECM/HPCM to determine the action of the driver applying the brake system and to provide this information to the vehicle subsystems via serial data.

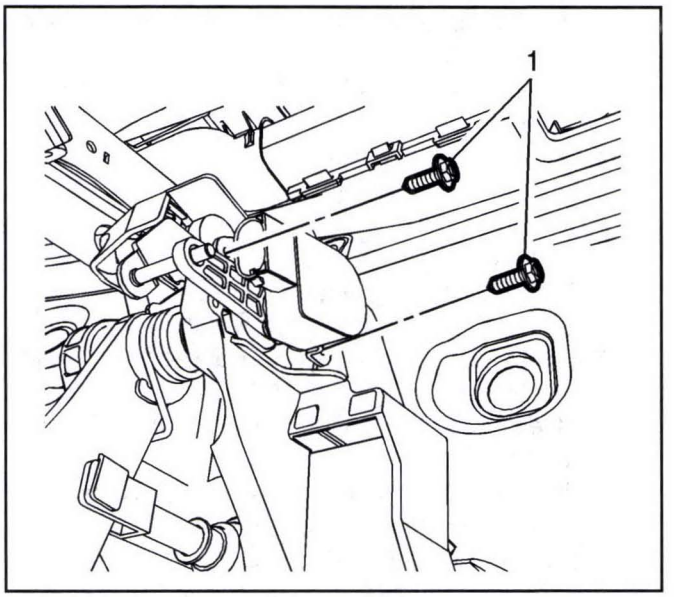
Calibration Procedure

1. Apply the parking brake.
2. Ignition ON, engine OFF, place the transmission in the PARK position for automatic transmission or NEUTRAL position for manual transmission.
3. Install a scan tool.
4. Clear all DTCs before proceeding.
5. Navigate to the Configuration/Reset Functions menu of the BCM.
6. Select the Brake Pedal Position Sensor Learn procedure and follow the directions displayed on the screen.

Brake Pedal Position Sensor Replacement (Travel Sensor)

Removal Procedure

1. Disconnect the brake pedal travel sensor electrical connector.
2. Remove the brake and accelerator pedal assembly. Refer to *Brake and Accelerator Pedal Assembly Replacement on page 5-173*.



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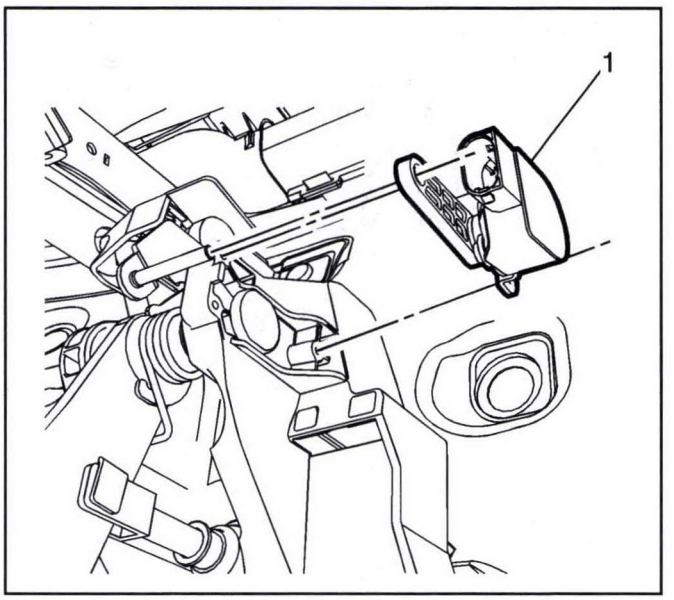
3. Remove the brake pedal travel sensor bolts (1).



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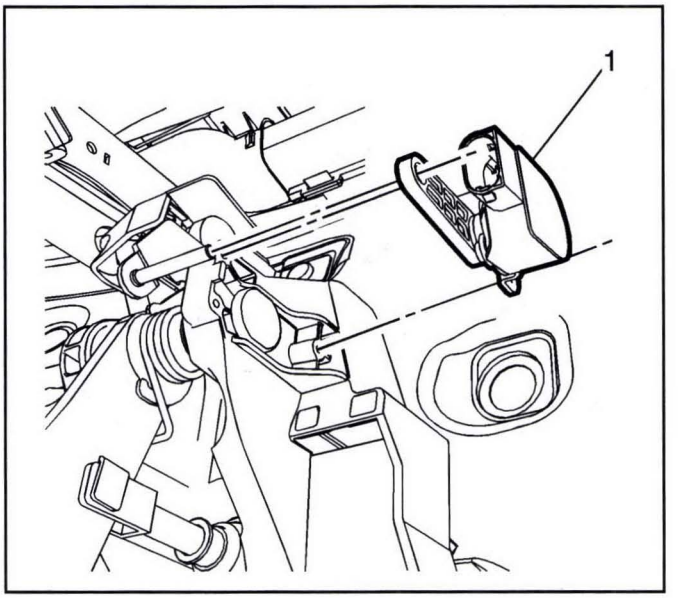
4. Remove the brake pedal position sensor (1).

Installation Procedure



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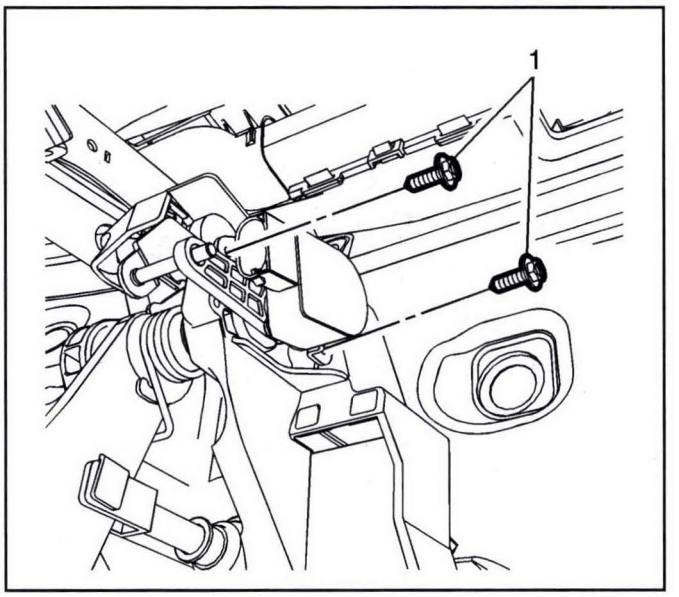
1. Position the brake pedal travel sensor arm to the brake pedal post and install the brake pedal position sensor (1).



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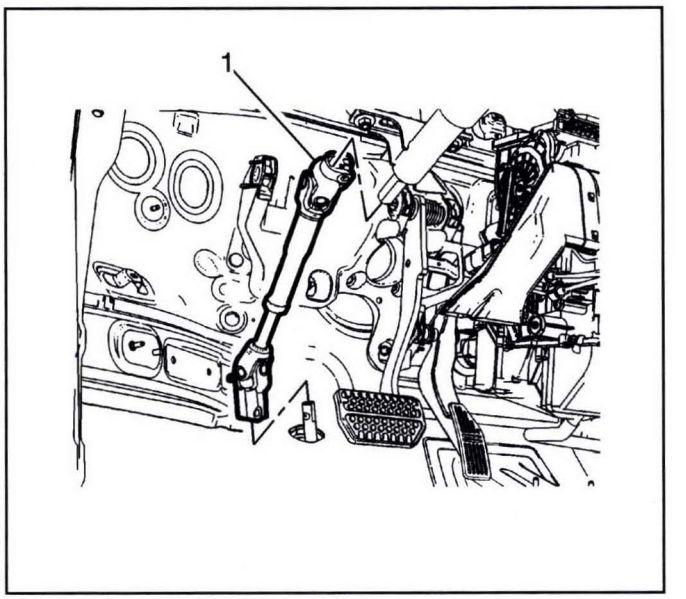
Caution: Refer to *Fastener Caution on page 0-8*.

2. Install the brake pedal travel sensor bolts (1) and tighten to **3 N•m (27 lb in)**.
3. Install the brake and accelerator pedal assembly. Refer to *Brake and Accelerator Pedal Assembly Replacement on page 5-173*.
4. Connect the brake pedal travel sensor electrical connector.

Brake Pedal Position Sensor Replacement (Apply Sensor)

Removal Procedure

1. Remove the instrument panel lower airbag bracket. Refer to *Instrument Panel Lower Airbag Bracket Replacement on page 12-153*.



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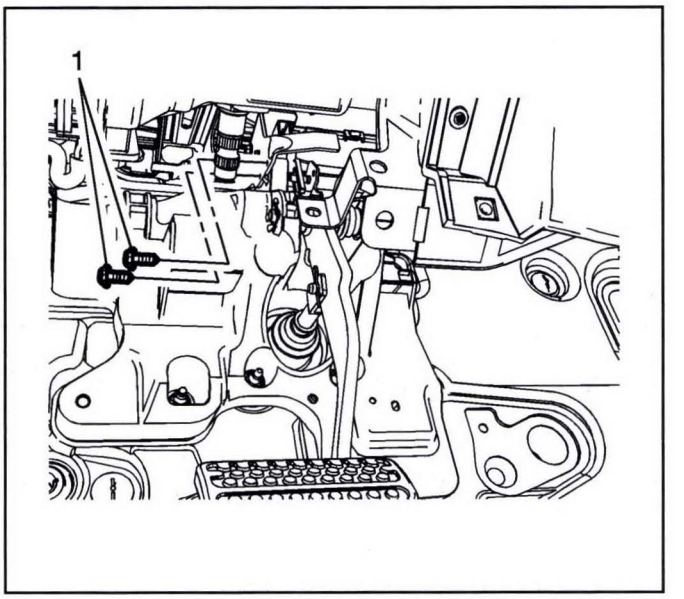
2. Remove the intermediate steering shaft (1). Refer to *Intermediate Steering Shaft Replacement on page 14-28*.
3. Disconnect the brake pedal position sensor electrical connector.



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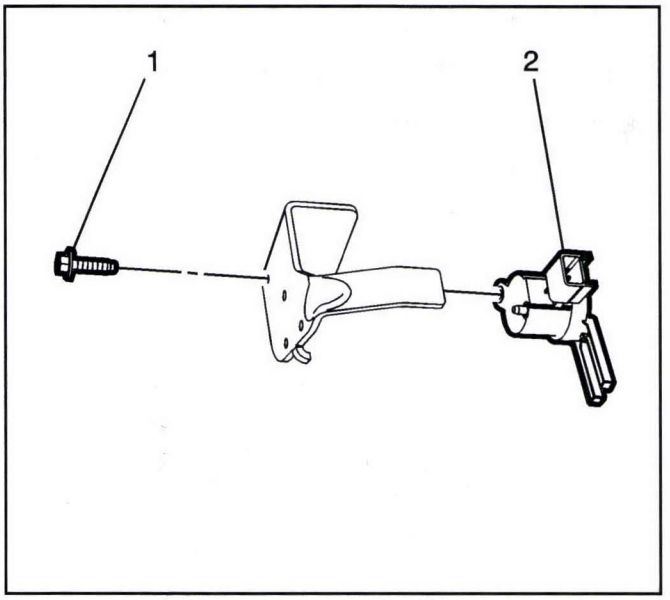
4. Remove the brake pedal position sensor bracket bolts (1).
5. Remove the brake pedal position sensor and bracket assembly.



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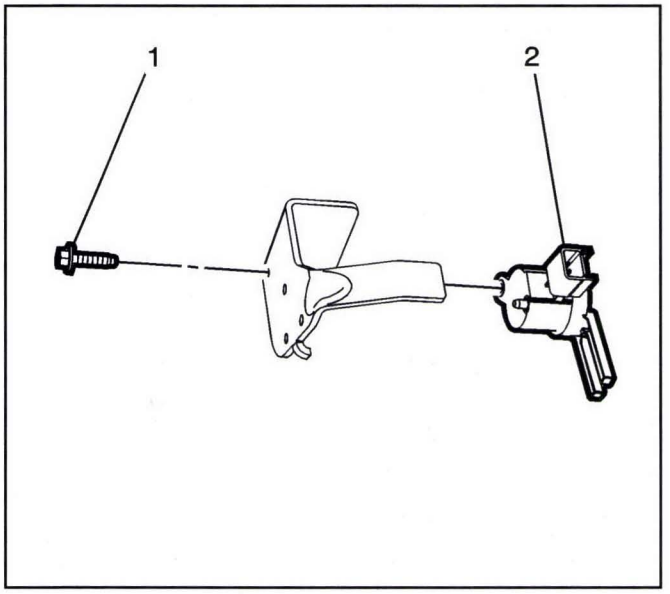
6. Remove the brake pedal position sensor bolt (1).
7. Remove the brake pedal position sensor (2) from the bracket.

Installation Procedure



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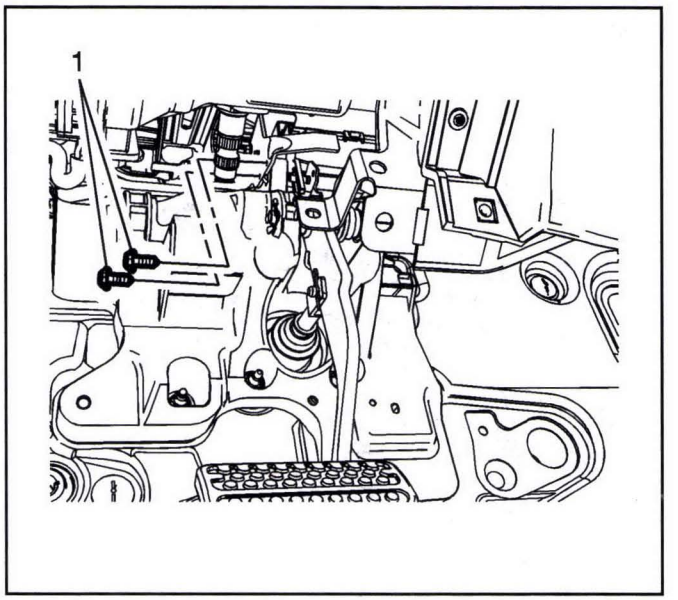
Note: Align the brake pedal position sensor pin to the brake pedal bracket.

1. Install the brake pedal position sensor bolt (1) through the bracket and to the brake pedal position sensor (2)..

Caution: Refer to *Fastener Caution on page 0-8*.

2. Tighten the brake pedal position sensor bolt to **3** N•m **(27 lb in)**



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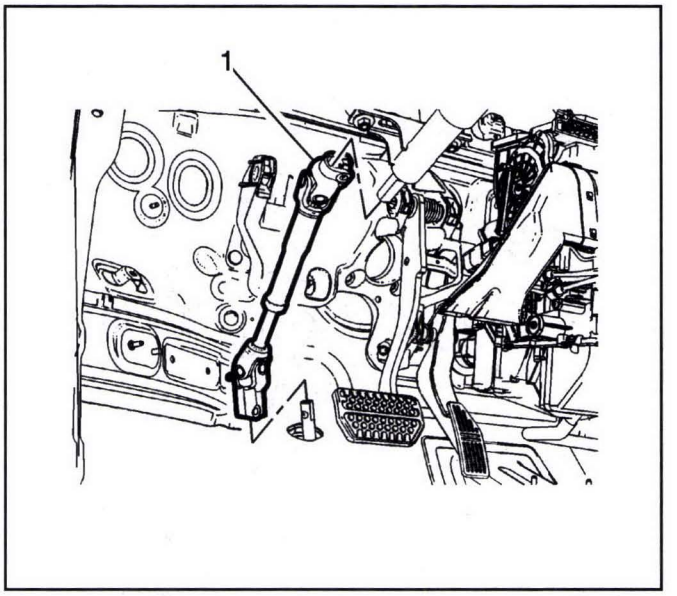
3. Install the brake pedal position sensor and bracket assembly to the brake and accelerator pedal assembly.
4. Install the brake pedal position sensor bracket bolts (1) and tighten to **3** N•m **(27 lb in)**.
5. Connect the brake pedal position sensor electrical connector.



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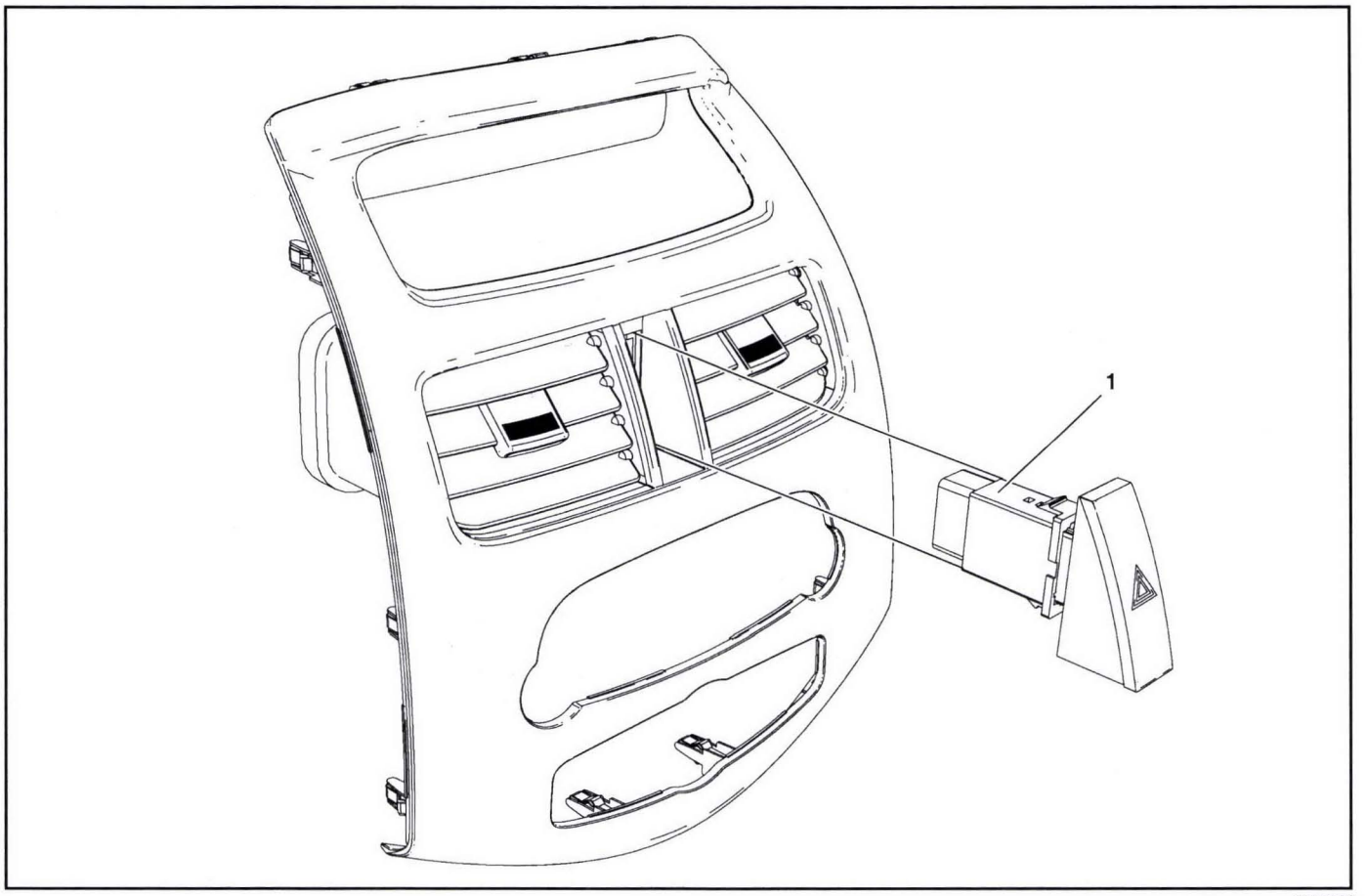
6. Install the intermediate steering shaft (1). Refer to *Intermediate Steering Shaft Replacement on page 14-28*.
7. Install the instrument panel lower airbag bracket. Refer to *Instrument Panel Lower Airbag Bracket Replacement on page 12-153*.
8. Calibrate the brake pedal position sensor. Refer to *Brake Pedal Position Sensor Calibration on page 4-170*.

Hazard Warning Switch Replacement

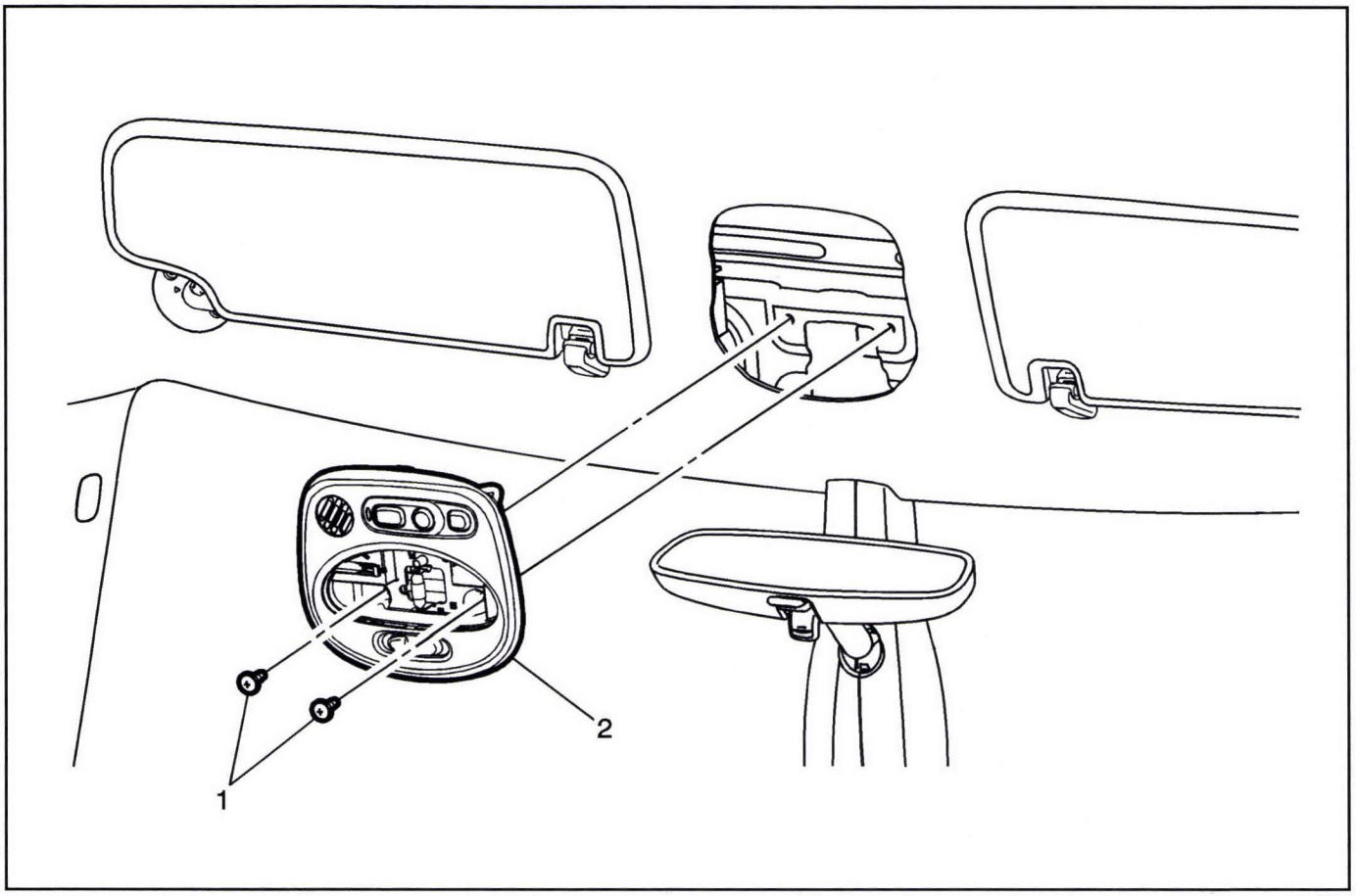


2327688

Hazard Warning Switch Replacement

Callout	Component Name
Preliminary Procedure Remove the instrument panel center trim plate applique. Refer to *Instrument Panel Center Trim Plate Applique Replacement on page 2-25*.	
1	Hazard Warning Switch **Procedure** 1. Disconnect the electrical connector. 2. Squeeze tabs on switch to unsnap from housing bracket.

Center Courtesy Lamp Replacement (North America)

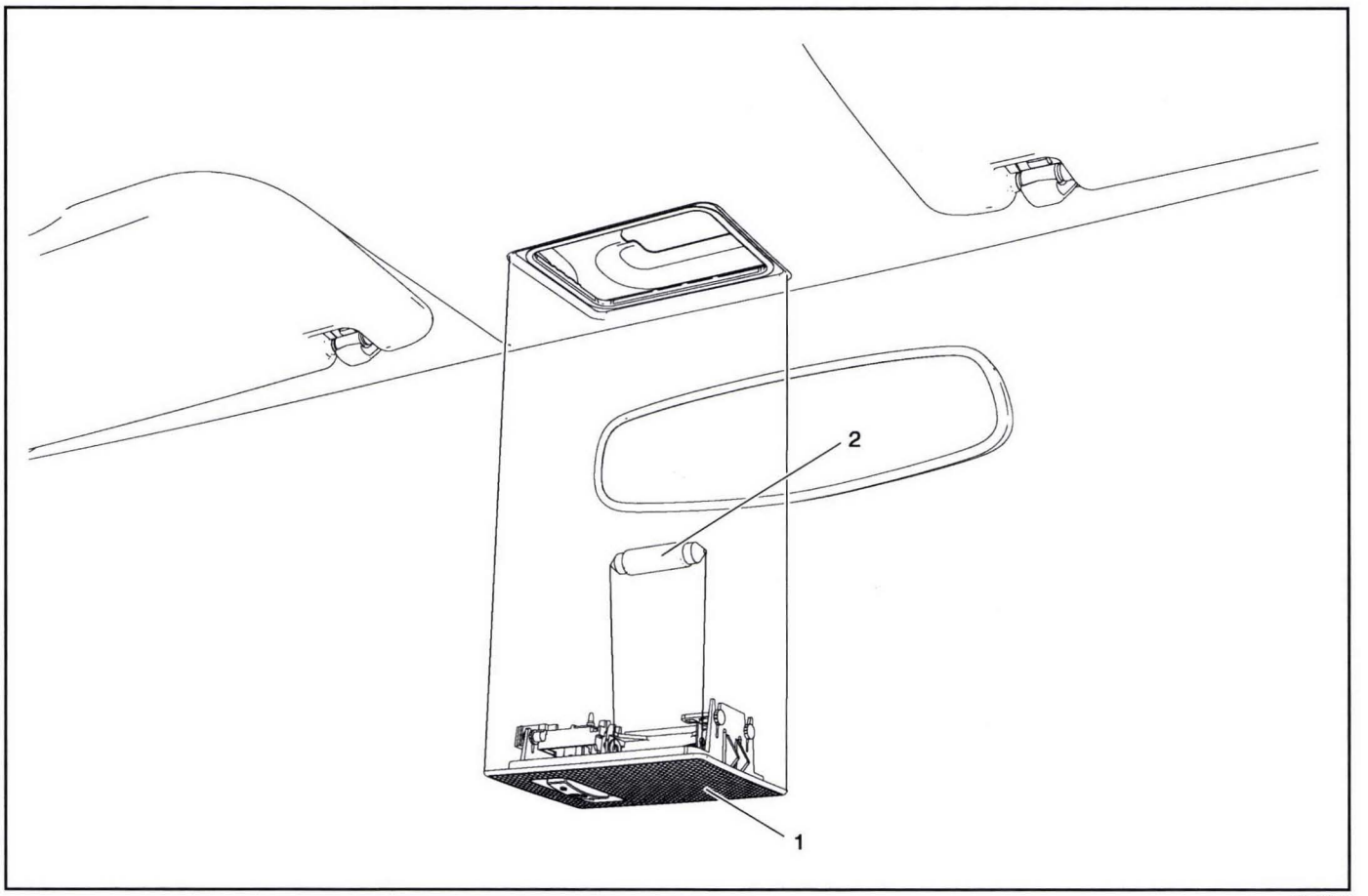


3212594

Center Courtesy Lamp Replacement (North America)

Callout	Component Name
1	Center Courtesy Lamp Fasteners (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Center Courtesy Lamp **Procedure** Disconnect the electrical connections.

Center Courtesy Lamp Replacement (Europe, Korea)

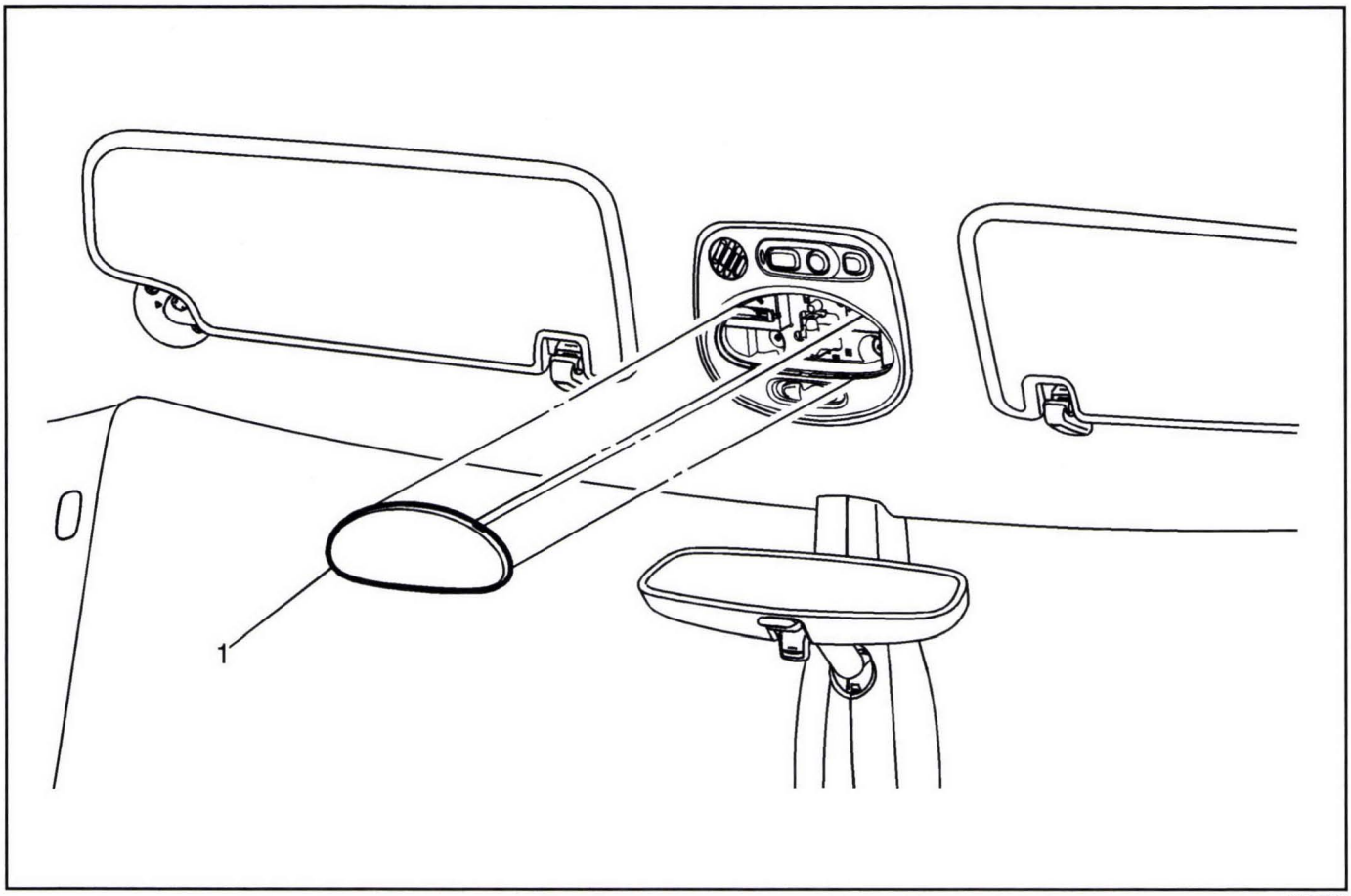


2327687

Center Courtesy Lamp Replacement (Europe, Korea)

Callout	Component Name
1	Dome Lamp
2	Dome Lamp Bulb (Qty: 1)

Center Courtesy Lamp Lens Replacement

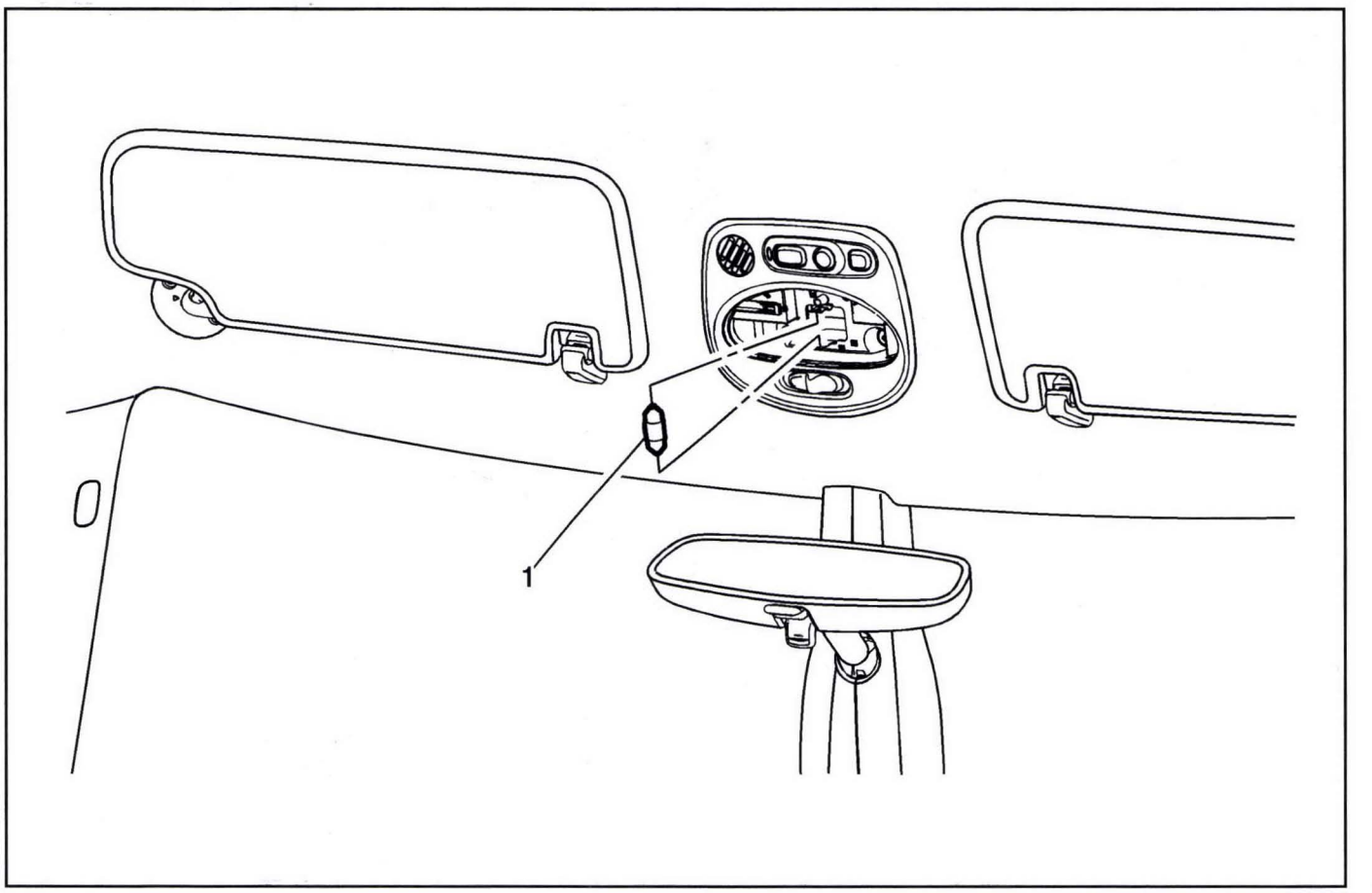


3212586

Center Courtesy Lamp Lens Replacement

Callout	Component Name
1	Center Courtesy Lamp Lens **Procedure** Using the appropriate tool, gently release the lens from the lamp assembly.

Center Courtesy Lamp Bulb Replacement

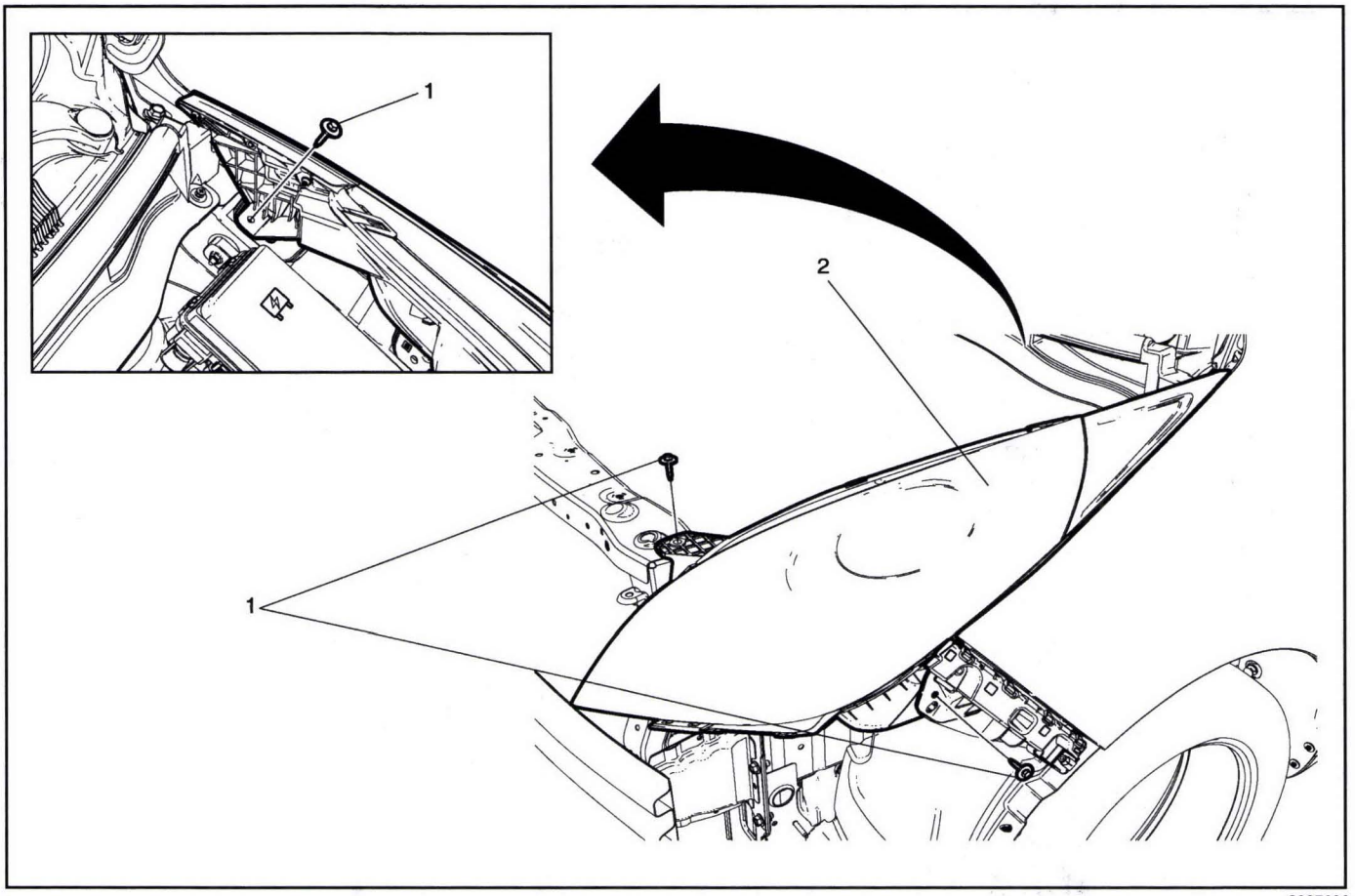


3212591

Center Courtesy Lamp Bulb Replacement

Callout	Component Name
Preliminary Procedure Remove the center courtesy lamp lens. Refer to *Center Courtesy Lamp Lens Replacement on page 4-176*.	
1	Center Courtesy Lamp Bulb **Procedure** Release the bulb from the lamp assembly tabs to remove.

Headlamp Replacement

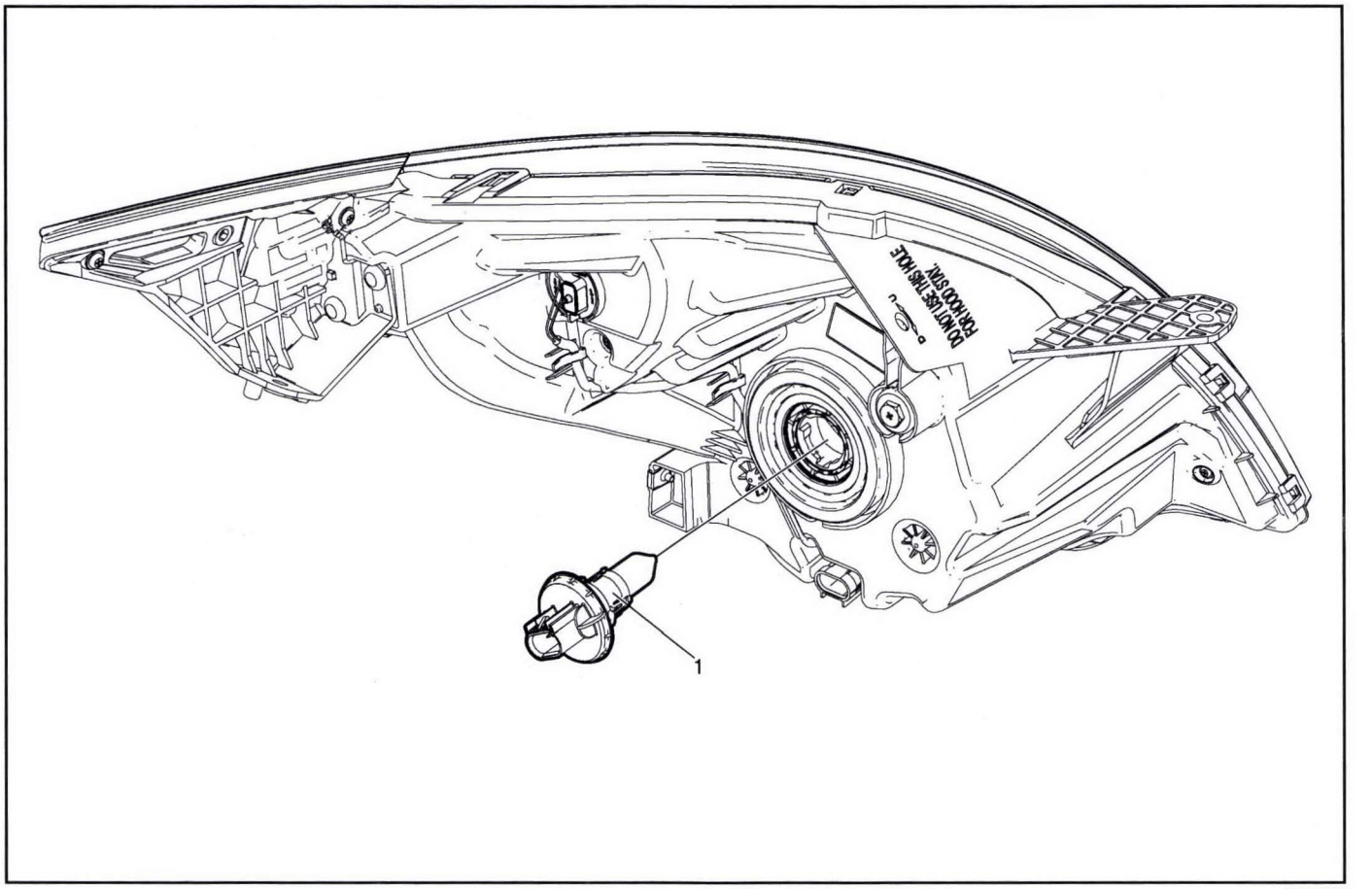


2327686

Headlamp Replacement

Callout	Component Name
Preliminary Procedure Remove the front bumper fascia. Refer to *Front Bumper Fascia Replacement on page 3-57*.	
1	Headlamp Screw (Qty: 3) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 2.5 N•m (22 lb in)
2	Headlamp Assembly **Procedure** 1. Pull the headlamp assembly forward far enough to access the electrical connection. 2. Disconnect the headlamp electrical connector from the forward lamp harness connector. 3. Remove the headlamp assembly. 4. Aim the headlamps after installation. Refer to *Headlamp Aiming (North America) on page 4-183* or *Headlamp Aiming (Europe, Korea) on page 4-184*.

Headlamp Bulb Replacement (North America)

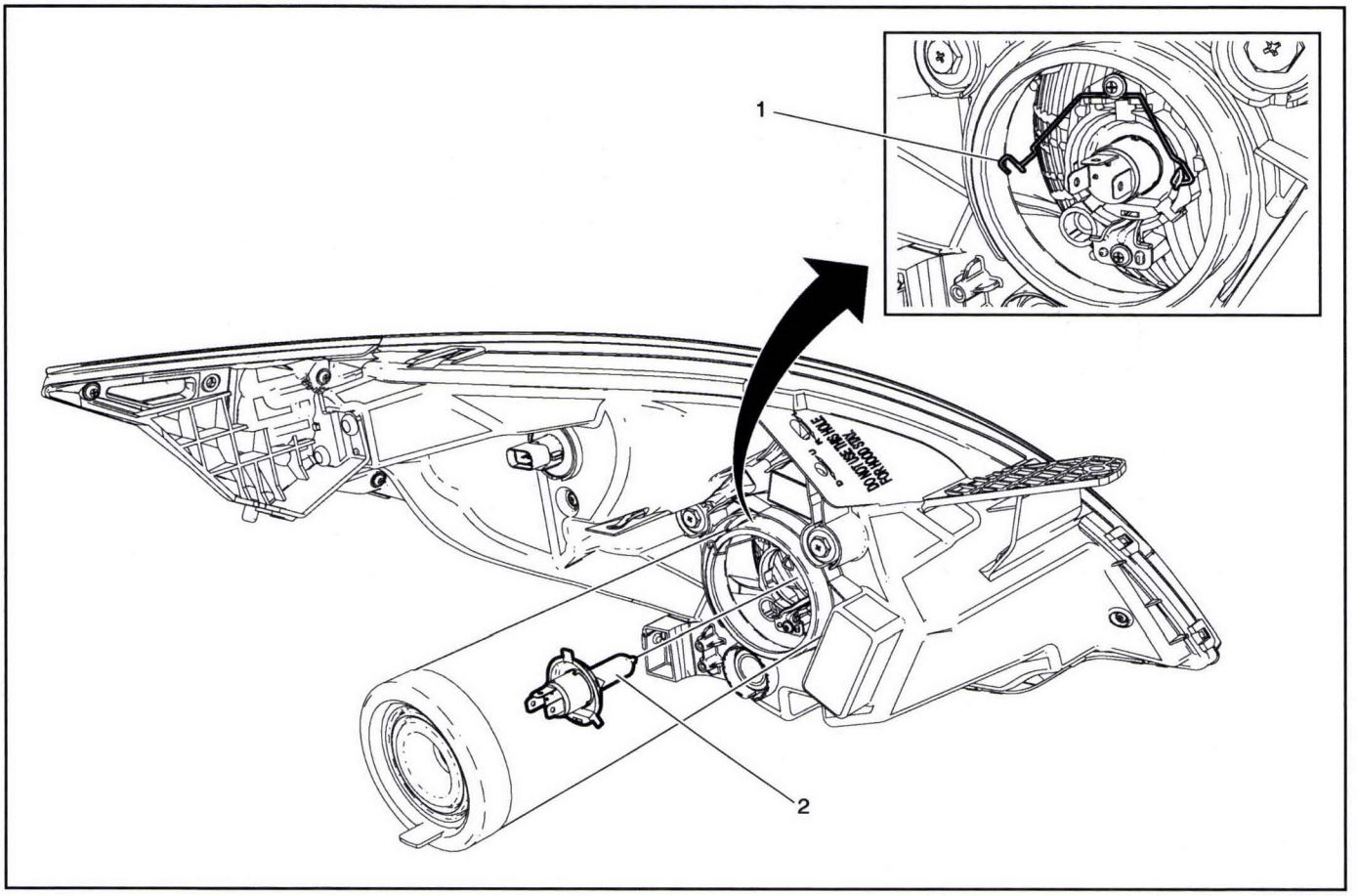


2754172

Headlamp Bulb Replacement (North America)

Callout	Component Name
1	Headlamp Bulb ***Warning: Refer to Halogen Bulb Warning on page 0-5.*** **Procedure** 1. Disconnect electrical connector. 2. Rotate the headlamp bulb counterclockwise to remove from the headlamp.

Headlamp Bulb Replacement (Europe, Korea)

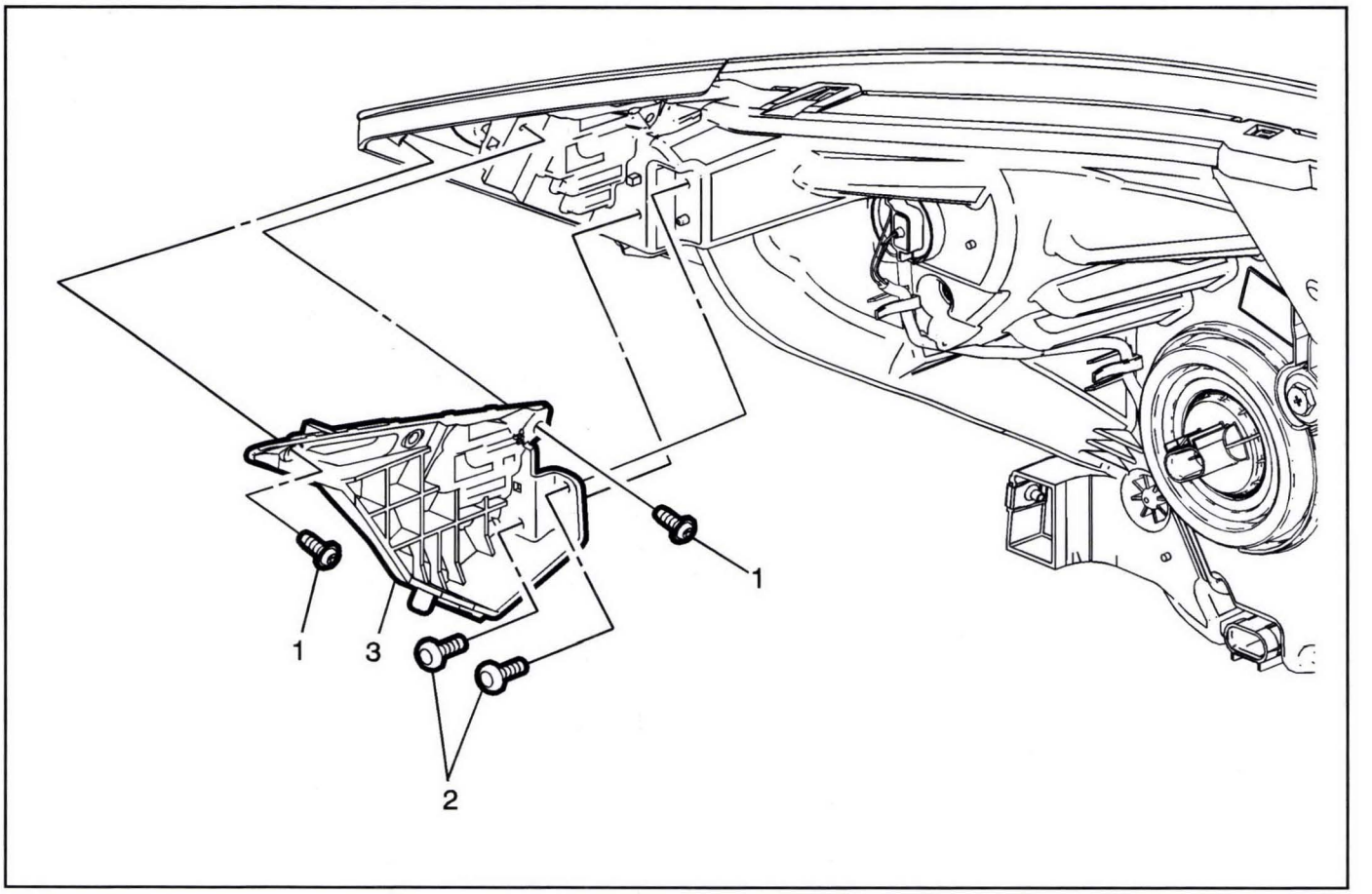


2327685

Headlamp Bulb Replacement (Europe, Korea)

Callout	Component Name
Preliminary Procedure Remove the headlamp bulb dust cover.	
1	Headlamp Bulb Socket Bracket **Tip:** Disconnect the electrical connector.
2	Headlamp Bulb ***Warning: Refer to Halogen Bulb Warning on page 0-5.*** **Procedure** Remove the bulb from the lamp socket.

Headlamp Bracket Replacement (North America)



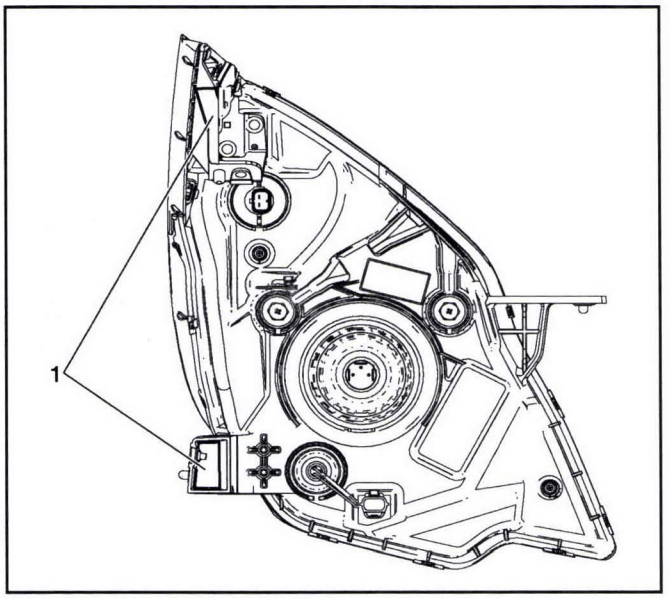
3040209

Headlamp Bracket Replacement (North America)

Callout	Component Name
Preliminary Procedure Remove the headlamp. Refer to *Headlamp Replacement on page 4-178*.	
1	Headlamp Screw (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Headlamp Screw (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*.
3	Headlamp Bracket

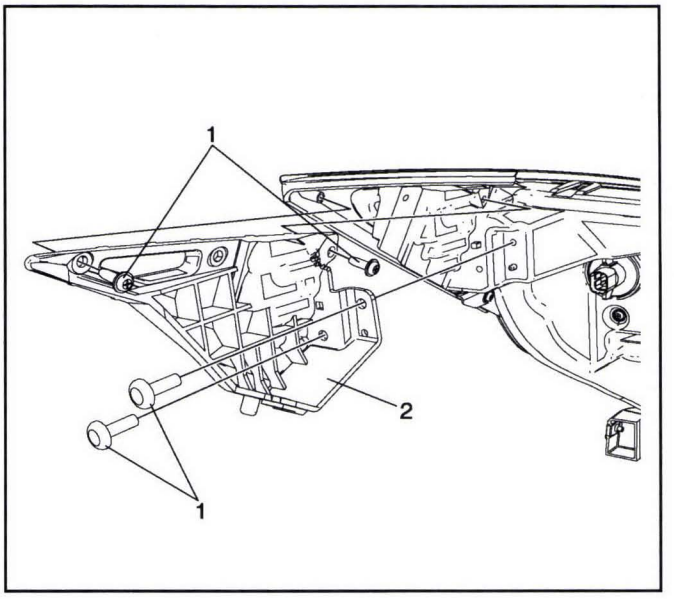
Headlamp Bracket Replacement (Europe, Korea)

Removal Procedure



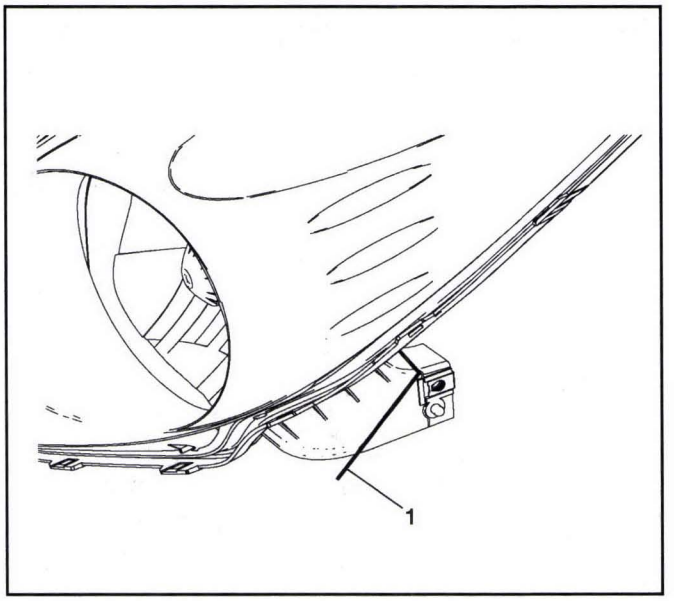
2421883

1. Remove the headlamp. Refer to *Headlamp Replacement on page 4-178*.
2. There are 2 replacement brackets (1) on each headlamp.



2421885

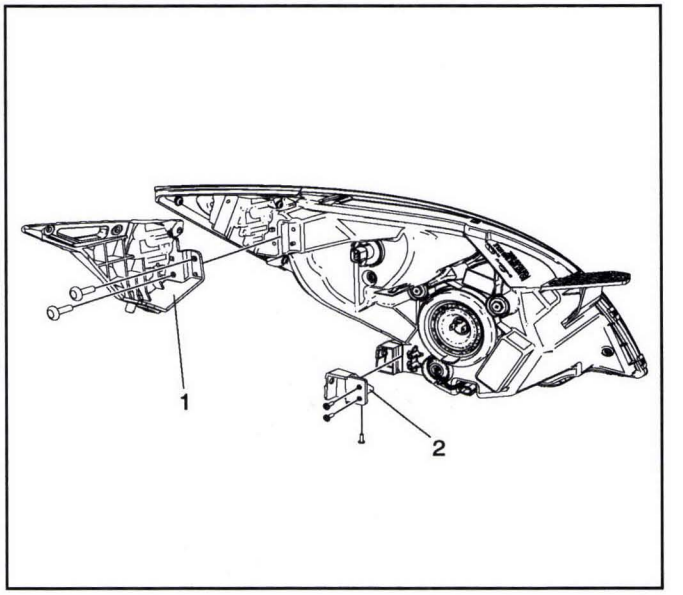
3. For bracket , 1 remove the screws (1) and bracket 1 (2).



2421886

4. For bracket 2, cut the bracket along the marked line (1).

Installation Procedure



2421887

1. For bracket 1, install the bracket (1) with the specified attachments.
2. For bracket 2, install the bracket (2) with the specified attachments.
3. Install the headlamp. Refer to *Headlamp Replacement on page 4-178*.

Headlamp Aiming (North America)

Visual Aiming Preparation Procedure

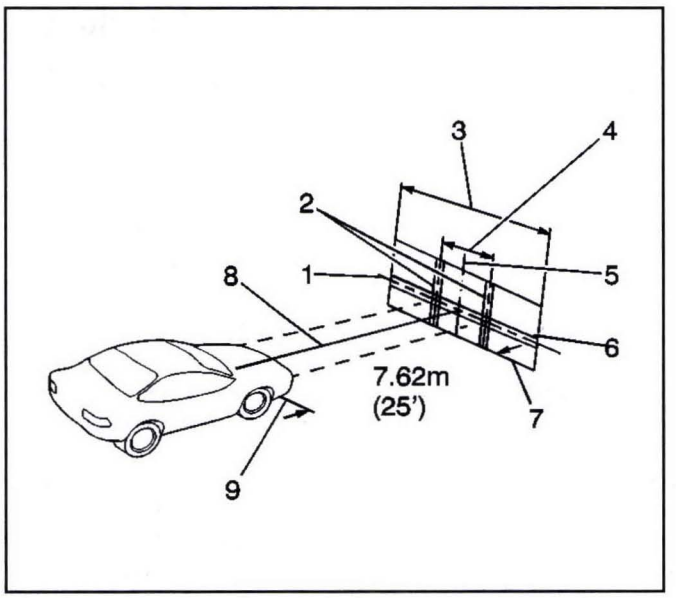
Note: Some state and local laws specify requirements for headlamp aim. Comply with all of these laws when performing any headlamp aiming operations.

Headlamp aim should be checked:

- When a new headlamp capsule is installed.
- If service or repairs to the front end area have, or may have, disturbed the headlamps or their mounting.

The aiming screen should meet the following criteria:

- The area will consist of a level surface large enough to allow for a vehicle and an additional 7.62 m (25 ft) measured from face of lamps to the front of the aiming screen.
- The screen will be 1.52 m (5 ft) high x 3.66 m (12 ft) wide with a matte white surface well shaded from extraneous light, and properly adjusted to the floor on which the vehicle stands. Provisions should be made to align the aiming screen parallel with the vehicle.
- The screen shall be provided with a fixed vertical centerline, two laterally adjustable vertical tapes, and one vertically adjustable horizontal tape.
- If a regular commercial aiming screen is not available, the screen may consist of a vertical wall having a clear uninterrupted area approximately 1.83 m (6 ft) high and 3.66 m (12 ft) wide. The surface should be finished with a washable non-gloss white paint.

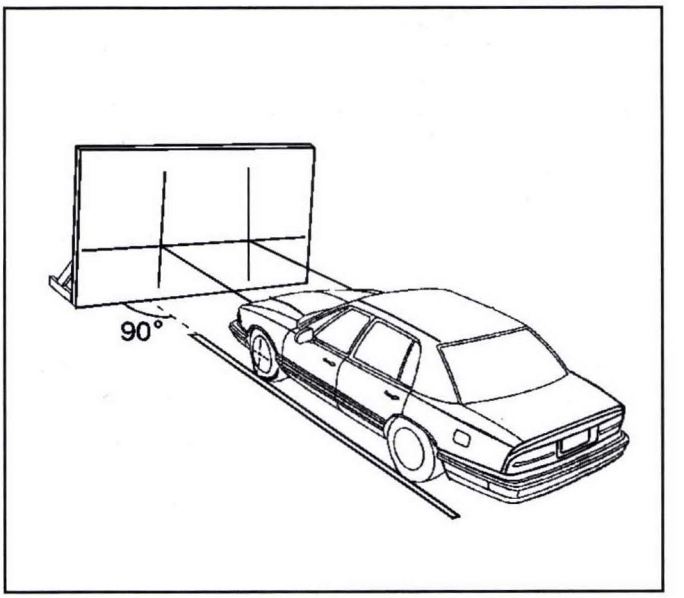


280087

- After the aiming screen has been set up in a permanent location, paint a reference line on the floor directly under the lens of the lamps to indicate the proper location of the headlamps when they are being aimed:
  - Distance between headlamps (1)
  - Center line of screen (2)
  - Adjustable vertical pointer (3)
  - Adjustable horizontal tape (4)
  - Diagram of light screen (5)
  - Vertical center line ahead of right headlamp pointer position (6)
  - 7.62 m (25 ft) (7)
  - Car axis (8)
  - Adjustable vertical pointer
  - Horizontal center line of lamps
  - Vertical center line ahead of left headlamp

Prior to aiming the headlamps, the following steps must be taken:

1. Remove any snow, ice or mud from the vehicle.
2. The vehicle must have a full tank of gas.
3. Stop all other work on the vehicle.
4. If any service has been performed on the vehicle, make sure that all of the components are back in their original place.
5. The vehicle must be on a level surface.

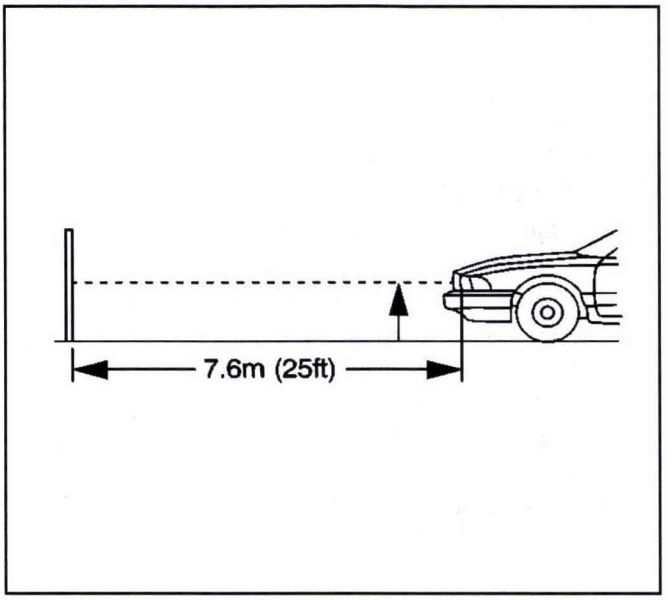


418380

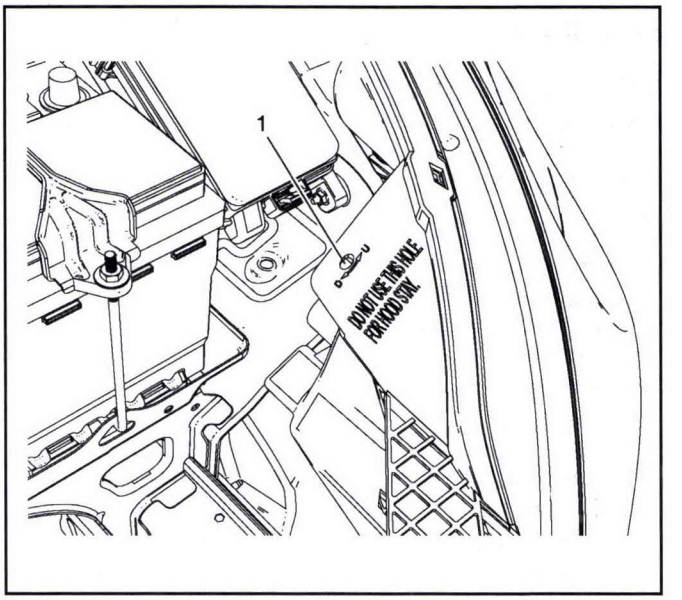
6. The vehicle left tires must be aligned with the reference line extending from the screen with the headlamps aligned with the reference line.
7. Do not load any cargo in the vehicle.
8. The vehicle must contain approximately 75 kg (165 lb) on the driver seat.
9. Inflate the tires to the proper pressure.
10. Simulate the vehicle loads if the intended use of the vehicle is for hauling heavy loads or towing a trailer.
11. Rock the vehicle in order to stabilize the suspension.
12. Turn on the headlamps to low beam and observe the left and the top edges of the high intensity zone on the screen. The edges of the high intensity zone should fall within the specifications.

Headlamp Aiming Procedure

1. Open the hood.

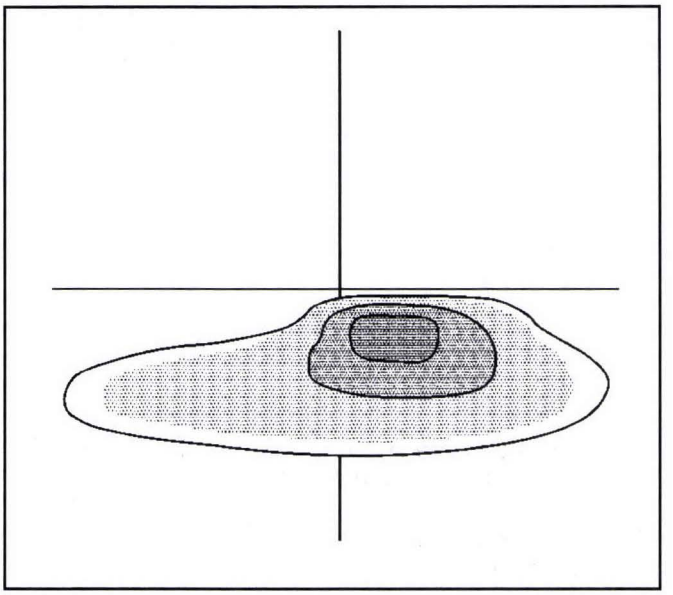


418400



2754176

2. Measure from the floor to the center of the headlamp bulb. Some headlamps have an aim dot marked on the headlamp lens.
3. At the screen, measure from the floor and place the horizontal tape at the measured distance.
4. Measure from the reference line on the floor to the left headlamp bulb centerline.
5. At the screen, measure from the reference line and place the vertical tape at the measured distance.
6. Measure from the reference line on the floor to the right headlamp bulb centerline.
7. At the screen, measure from the reference line and place the vertical tape at the measured distance.



476831

Note: DO NOT cover the headlamp. This may cause excessive heat build up.

8. Turn ON the low beam headlamps. Block the light from projecting onto the screen from the passenger side headlamp.
9. Adjust the vertical aim screw (1) of the headlamps to the specifications required by the state and the local authorities, or as shown in step number 8.
10. Repeat the aiming procedure for the passenger side headlamp while blocking the light from projecting onto the screen from the driver side headlamp.
11. Turn the headlamps OFF.
12. Close the hood.

Headlamp Aiming (Europe, Korea)

Visual Aiming Preparation Procedure

Note: Some state and local laws specify requirements for headlamp aim. Comply with all of these laws when performing any headlamp aiming operations.

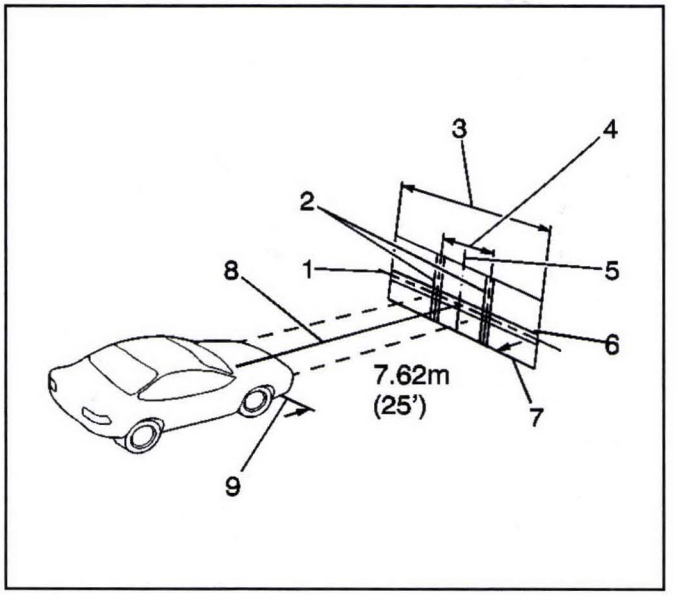
Headlamp aim should be checked:

- When a new headlamp capsule is installed.
- If service or repairs to the front end area have, or may have, disturbed the headlamps or their mounting.

The aiming screen should meet the following criteria:

- The area will consist of a level surface large enough to allow for a vehicle and an additional 7.62 m (25 ft) measured from face of lamps to the front of the aiming screen.
- The screen will be 1.52 m (5 ft) high x 3.66 m (12 ft) wide with a matte white surface well shaded from extraneous light, and properly adjusted to the floor on which the vehicle stands. Provisions should be made to align the aiming screen parallel with the vehicle.
- The screen shall be provided with a fixed vertical centerline, two laterally adjustable vertical tapes, and one vertically adjustable horizontal tape.
- If a regular commercial aiming screen is not available, the screen may consist of a vertical wall having a clear uninterrupted area approximately

1.83 m (6 ft) high and 3.66 m (12 ft) wide. The surface should be finished with a washable non-gloss white paint.

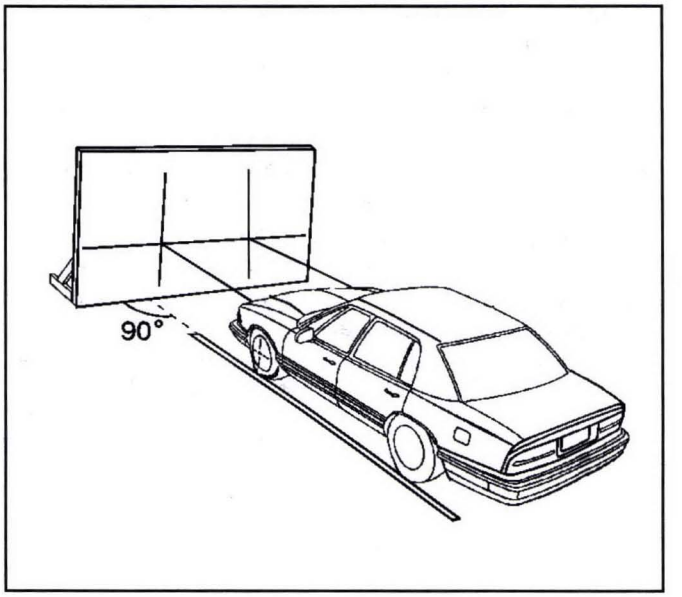


280087

- After the aiming screen has been set up in a permanent location, paint a reference line on the floor directly under the lens of the lamps to indicate the proper location of the headlamps when they are being aimed:
  - Distance between headlamps (1)
  - Center line of screen (2)
  - Adjustable vertical pointer (3)
  - Adjustable horizontal tape (4)
  - Diagram of light screen (5)
  - Vertical center line ahead of right headlamp pointer position (6)
  - 7.62 m (25 ft) (7)
  - Car axis (8)
  - Adjustable vertical pointer
  - Horizontal center line of lamps
  - Vertical center line ahead of left headlamp

Prior to aiming the headlamps, the following steps must be taken:

1. Remove any snow, ice or mud from the vehicle.
2. The vehicle must have a full tank of gas.
3. Stop all other work on the vehicle.
4. If any service has been performed on the vehicle, make sure that all of the components are back in their original place.
5. The vehicle must be on a level surface.

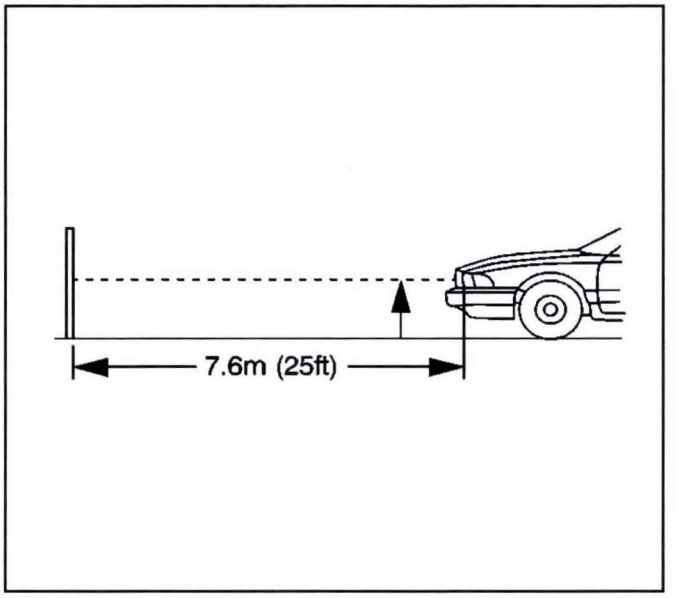


418380

6. The vehicle left tires must be aligned with the reference line extending from the screen with the headlamps aligned with the reference line.
7. Do not load any cargo in the vehicle.
8. The vehicle must contain approximately 75 kg (165 lb) on the driver seat.
9. Inflate the tires to the proper pressure.
10. Simulate the vehicle loads if the intended use of the vehicle is for hauling heavy loads or towing a trailer.
11. Rock the vehicle in order to stabilize the suspension.
12. Turn on the headlamps to low beam and observe the left and the top edges of the high intensity zone on the screen. The edges of the high intensity zone should fall within the specifications.

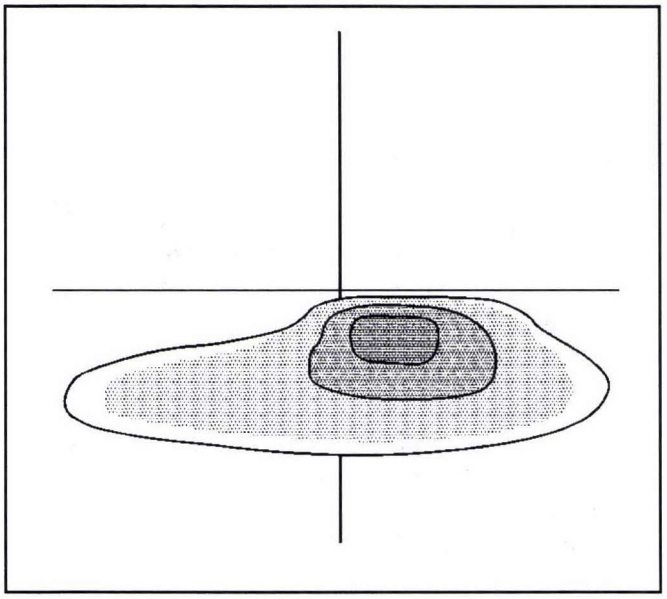
Headlamp Aiming Procedure

1. Open the hood.



418400

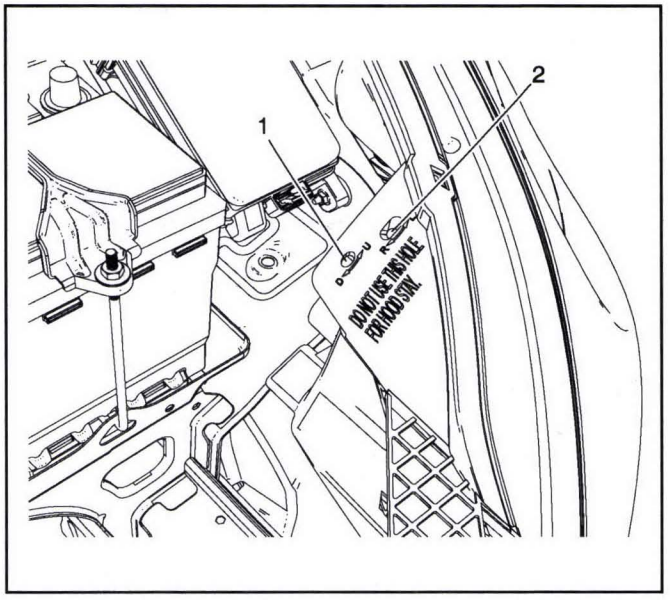
2. Measure from the floor to the center of the headlamp bulb. Some headlamps have an aim dot marked on the headlamp lens.
3. At the screen, measure from the floor and place the horizontal tape at the measured distance.
4. Measure from the reference line on the floor to the left headlamp bulb centerline.
5. At the screen, measure from the reference line and place the vertical tape at the measured distance.
6. Measure from the reference line on the floor to the right headlamp bulb centerline.
7. At the screen, measure from the reference line and place the vertical tape at the measured distance.



476831

Note: DO NOT cover the headlamp. This may cause excessive heat build up.

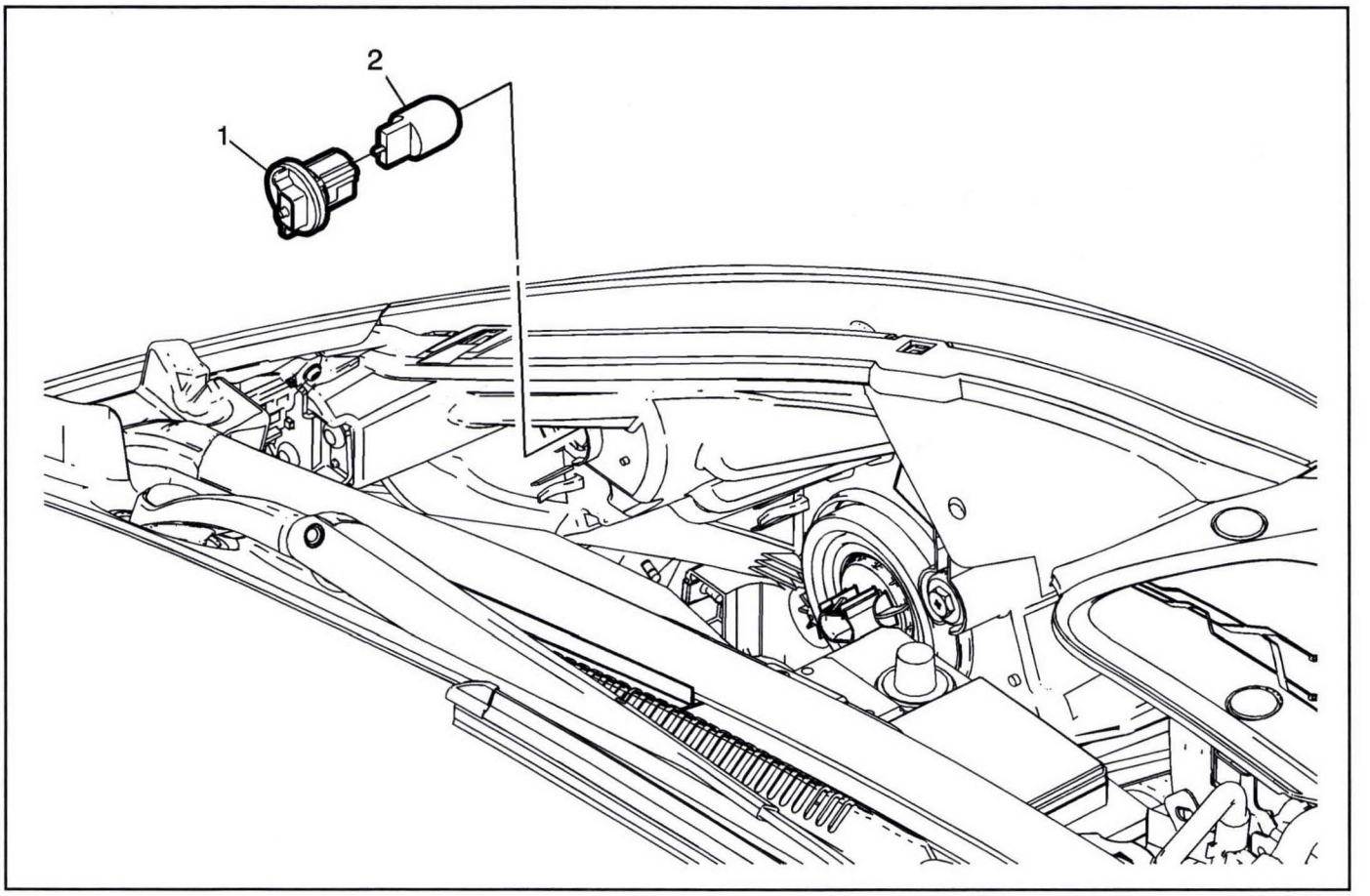
8. Turn ON the low beam headlamps. Block the light from projecting onto the screen from the passenger side headlamp.



2327684

9. Adjust the vertical aim screw (1) and horizontal aim screw (2) of the headlamps to the specifications required by the state and the local authorities, or as shown in step number 8.
10. Repeat the aiming procedure for the passenger side headlamp while blocking the light from projecting onto the screen from the driver side headlamp.
11. Turn the headlamps OFF.
12. Close the hood.

Front Turn Signal Lamp Bulb Replacement (North America)

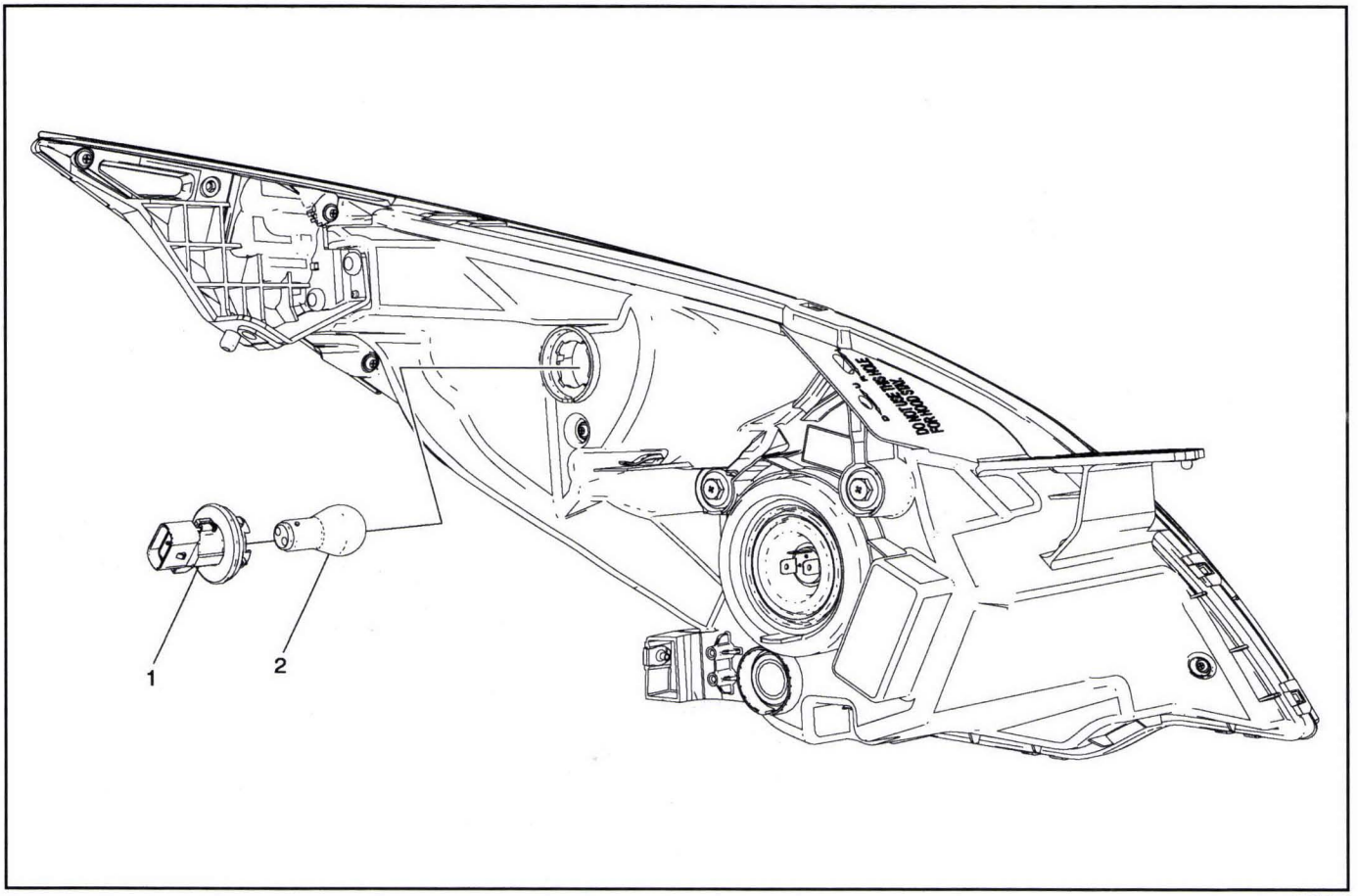


3040210

Front Turn Signal Lamp Bulb Replacement (North America)

Callout	Component Name
Preliminary Procedure Open and support hood.	
1	Headlamp Socket **Procedure** Rotate counterclockwise and pull from headlamp.
2	Front Turn Signal Lamp Bulb **Procedure** Pull front turn signal lamp bulb straight out of headlamp socket.

Front Turn Signal Lamp Bulb Replacement (Europe, Korea)

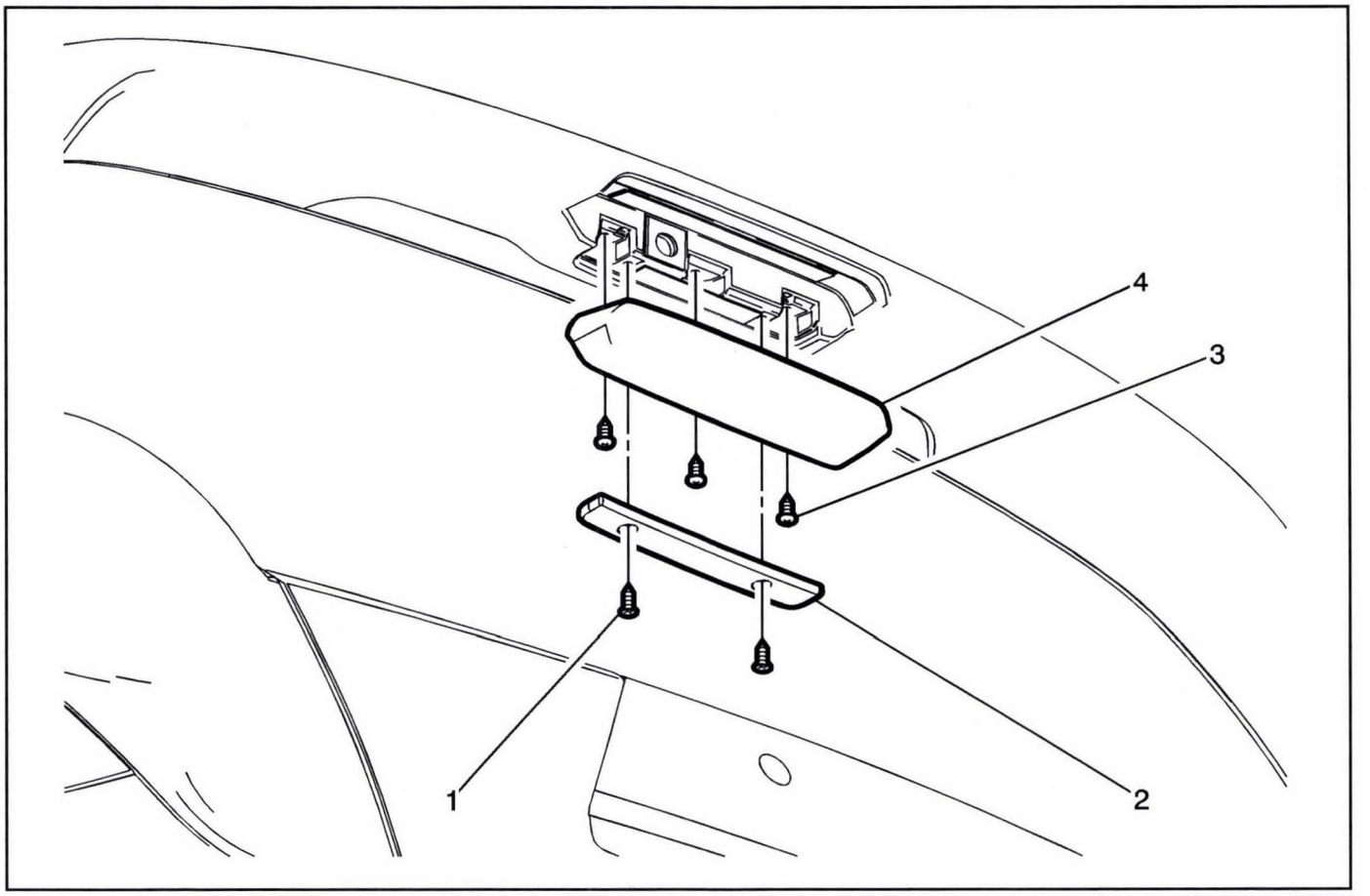


2327678

Front Turn Signal Lamp Bulb Replacement (Europe, Korea)

Callout	Component Name
1	Park/Turn Signal Bulb Socket ***Warning: Refer to Halogen Bulb Warning on page 0-5.*** **Tip:** Rotate counterclockwise and remove the socket from the headlamp assembly.
2	Park/Turn Signal Bulb **Procedure** Remove the bulb from the bulb socket.

High Mount Stop Lamp Replacement

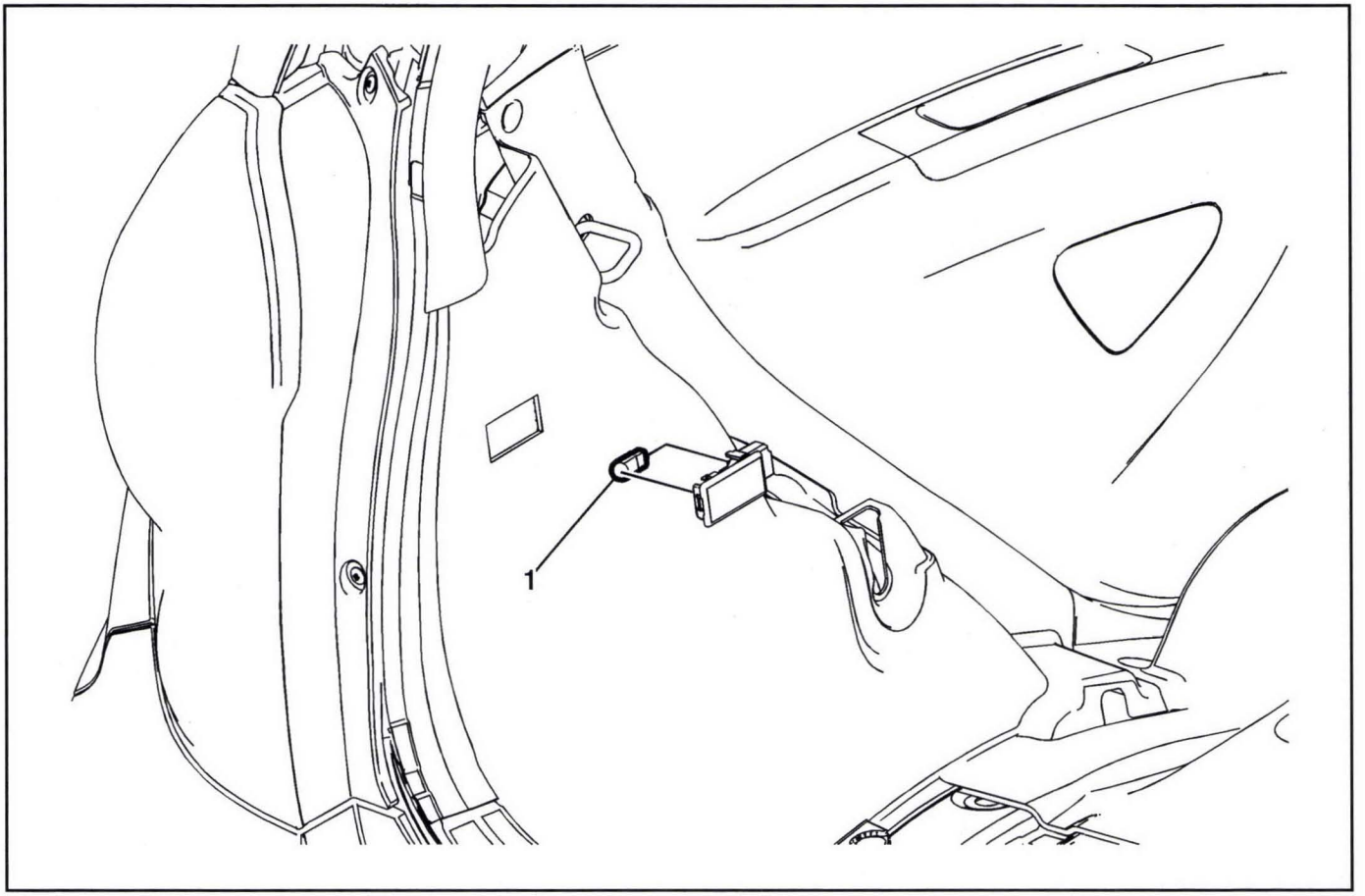


3136464

High Mount Stop Lamp Replacement

Callout	Component Name
1	Rear End Spoiler Bolt (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 0.6 N•m (5 lb in)
2	Rear End Spoiler Retainer Cover
3	High Mount Stop Lamp Bolt (Qty: 3) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 1.0 N•m (9 lb in)
4	High Mount Stop Lamp **Procedure** Disconnect the electrical connector.

Cargo Center Courtesy Lamp Bulb Replacement

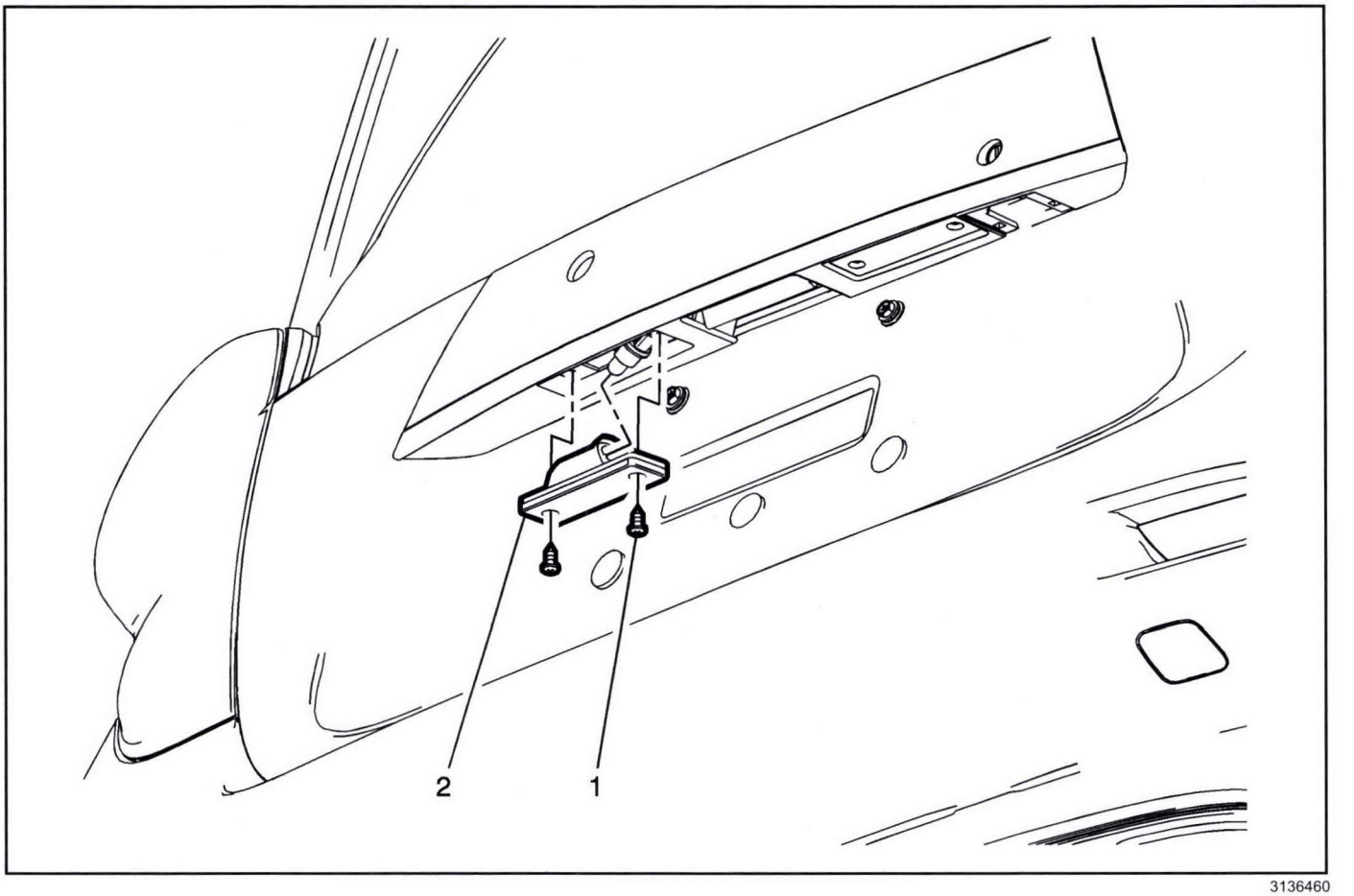


3213934

Cargo Center Courtesy Lamp Bulb Replacement

Callout	Component Name
Preliminary Procedure Remove the rear compartment courtesy lamp. Refer to *Rear Compartment Courtesy Lamp Replacement on page 4-198*.	
1	Cargo Center Courtesy Lamp Bulb

Rear License Plate Lamp Replacement

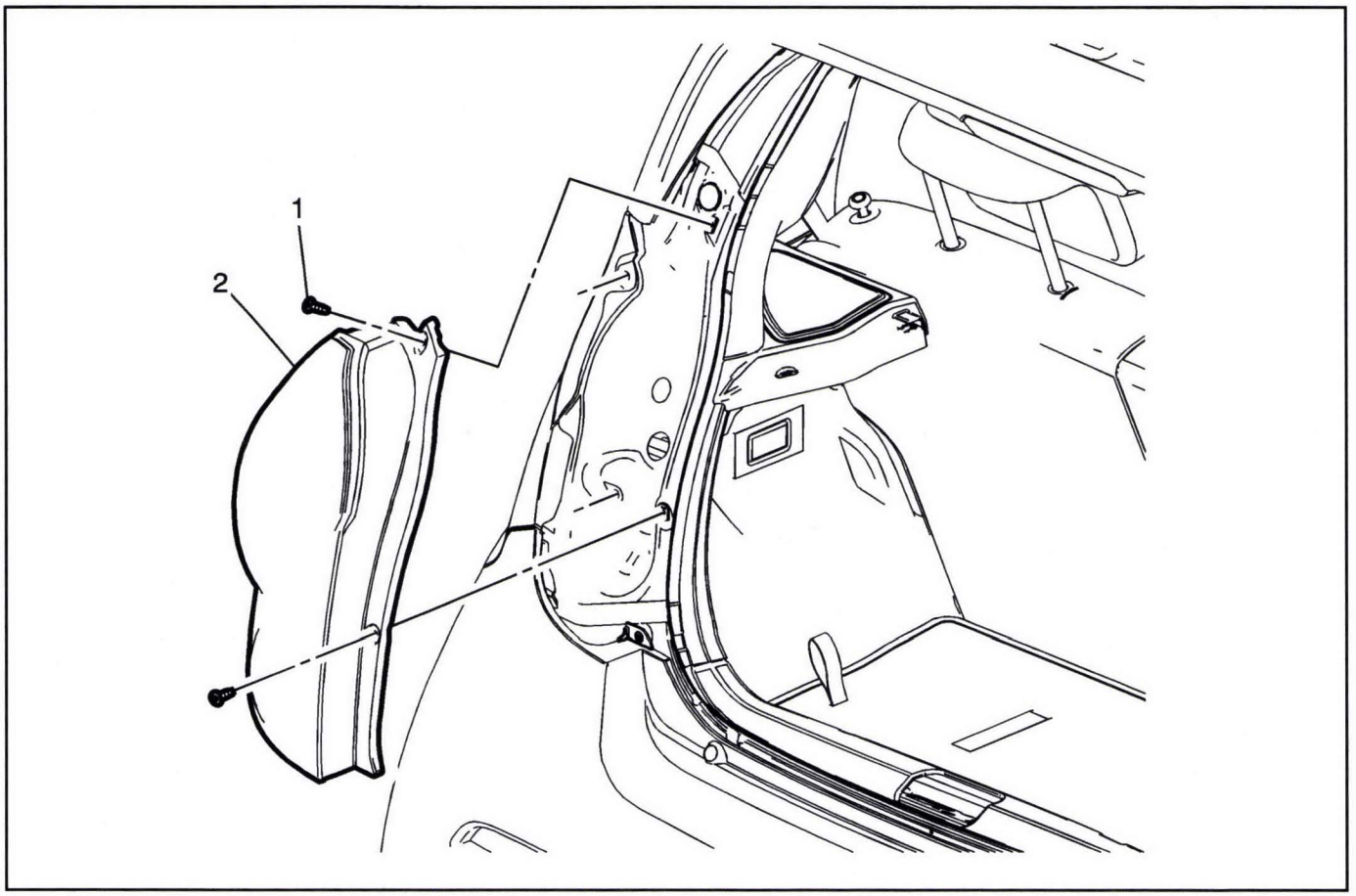


3136460

Rear License Plate Lamp Replacement

Callout	Component Name
1	Rear License Plate Lamp Bolt (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 2.5 N•m (22 lb in)
2	Rear License Plate Lamp **Procedure** Rotate the rear license plate lamp socket counterclockwise and pull from the rear license plate lamp.

Tail Lamp Replacement

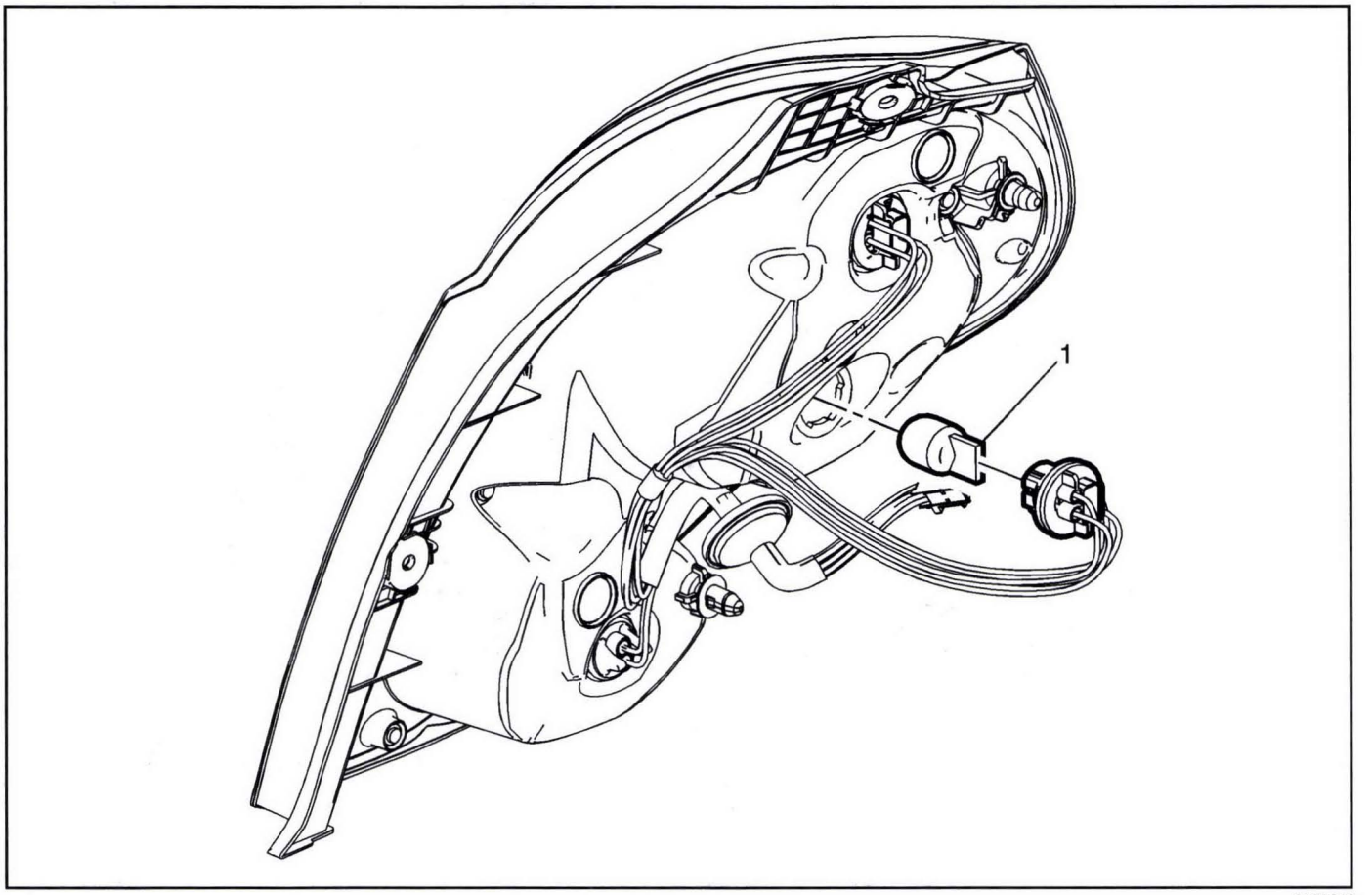


3136446

Tail Lamp Replacement

Callout	Component Name
Preliminary Procedure Open and support the liftgate.	
1	Tail Lamp Bolt (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 2.5 N•m (22 lb in)
2	Tail Lamp **Procedure** 1. Firmly pull tail lamp rearward to disengage the 2 retainers. 2. Disconnect the grommet and electrical connector. 3. Remove the tail lamp from the vehicle.

Tail and Turn Signal Lamp Bulb Replacement (North America)

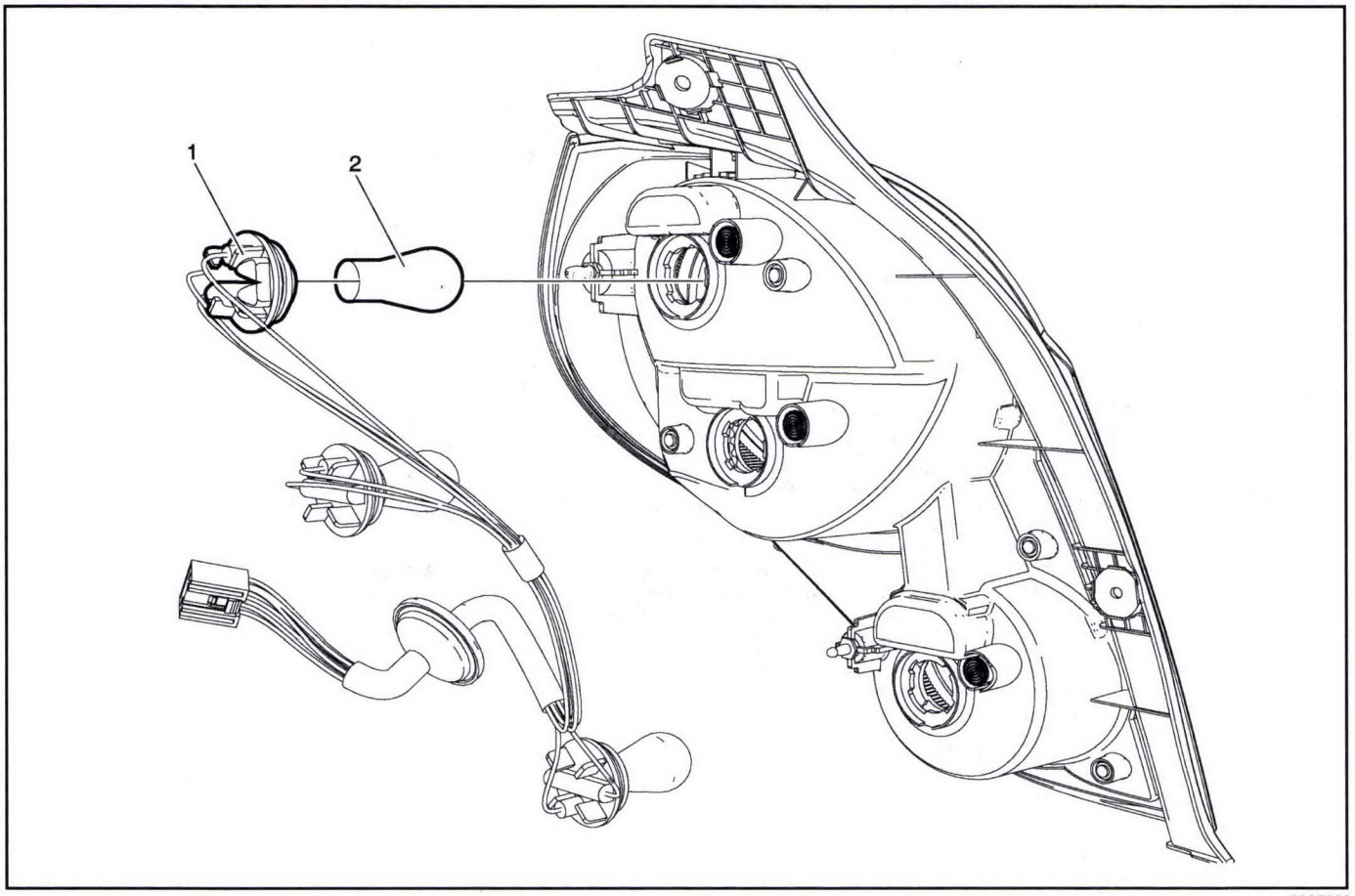


3153819

Tail and Turn Signal Lamp Bulb Replacement (North America)

Callout	Component Name
Preliminary Procedure Remove the tail lamp. Refer to *Tail Lamp Replacement on page 4-192*.	
1	Tail and Turn Signal Lamp Bulb **Procedure** 1. Turn the rear lamp monitor light conductor harness socket counterclockwise and pull from the tail lamp. 2. Pull the stop and tail lamp bulb straight from the rear lamp monitor light conductor harness socket.

Tail and Turn Signal Lamp Bulb Replacement (Europe, Korea)

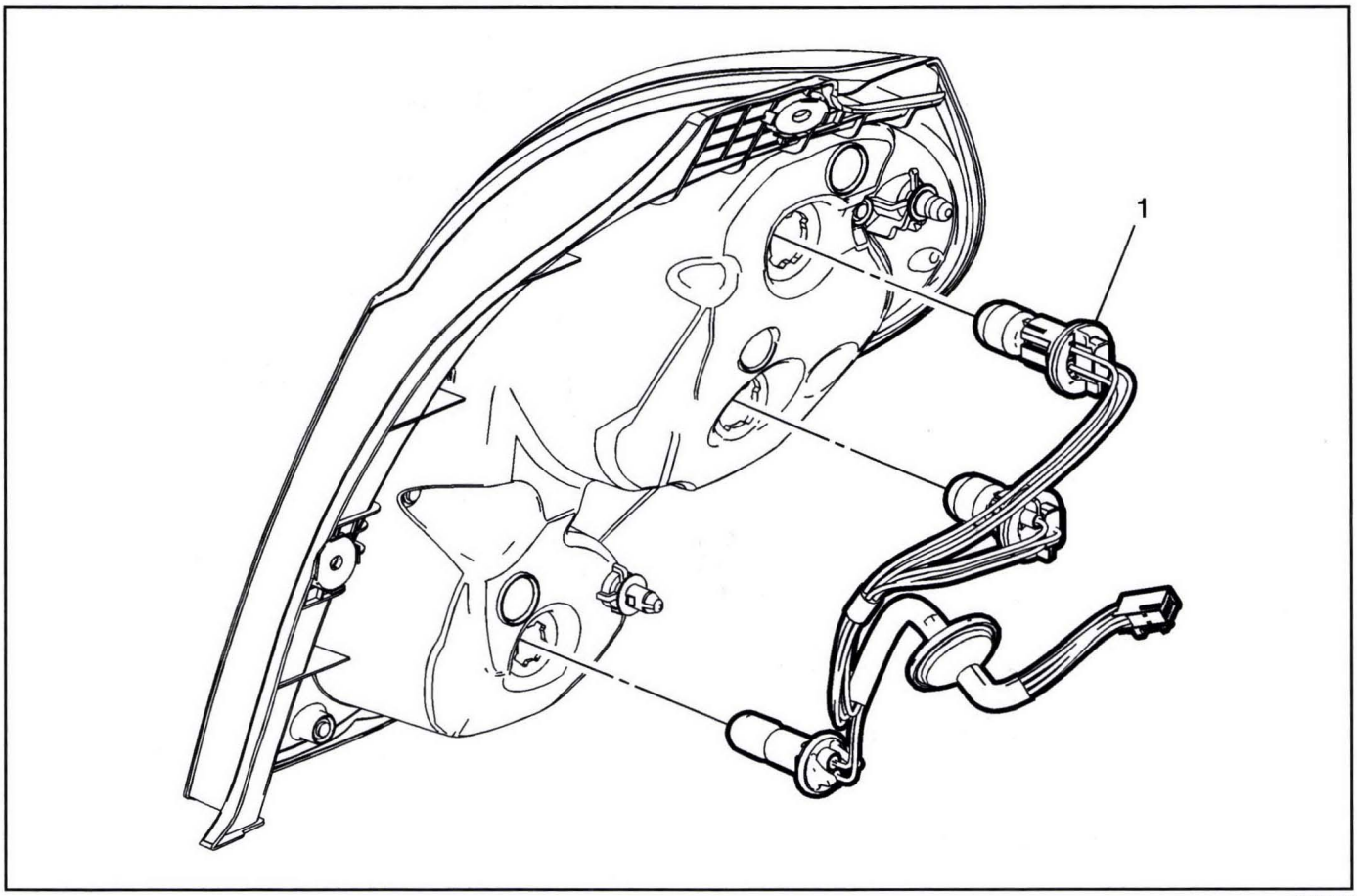


2327668

Tail and Turn Signal Lamp Bulb Replacement (Europe, Korea)

Callout	Component Name
Preliminary Procedure Remove the tail lamp assembly. Refer to *Tail Lamp Replacement on page 4-192*.	
1	Tail Lamp Bulb Harness Socket ***Warning: Refer to Halogen Bulb Warning on page 0-5.*** **Procedure** Rotate the bulb socket from the tail lamp housing.
2	Tail Lamp Bulb **Procedure** Rotate the bulb from the lamp harness socket.

Rear Lamp Monitor Light Conductor Harness Replacement

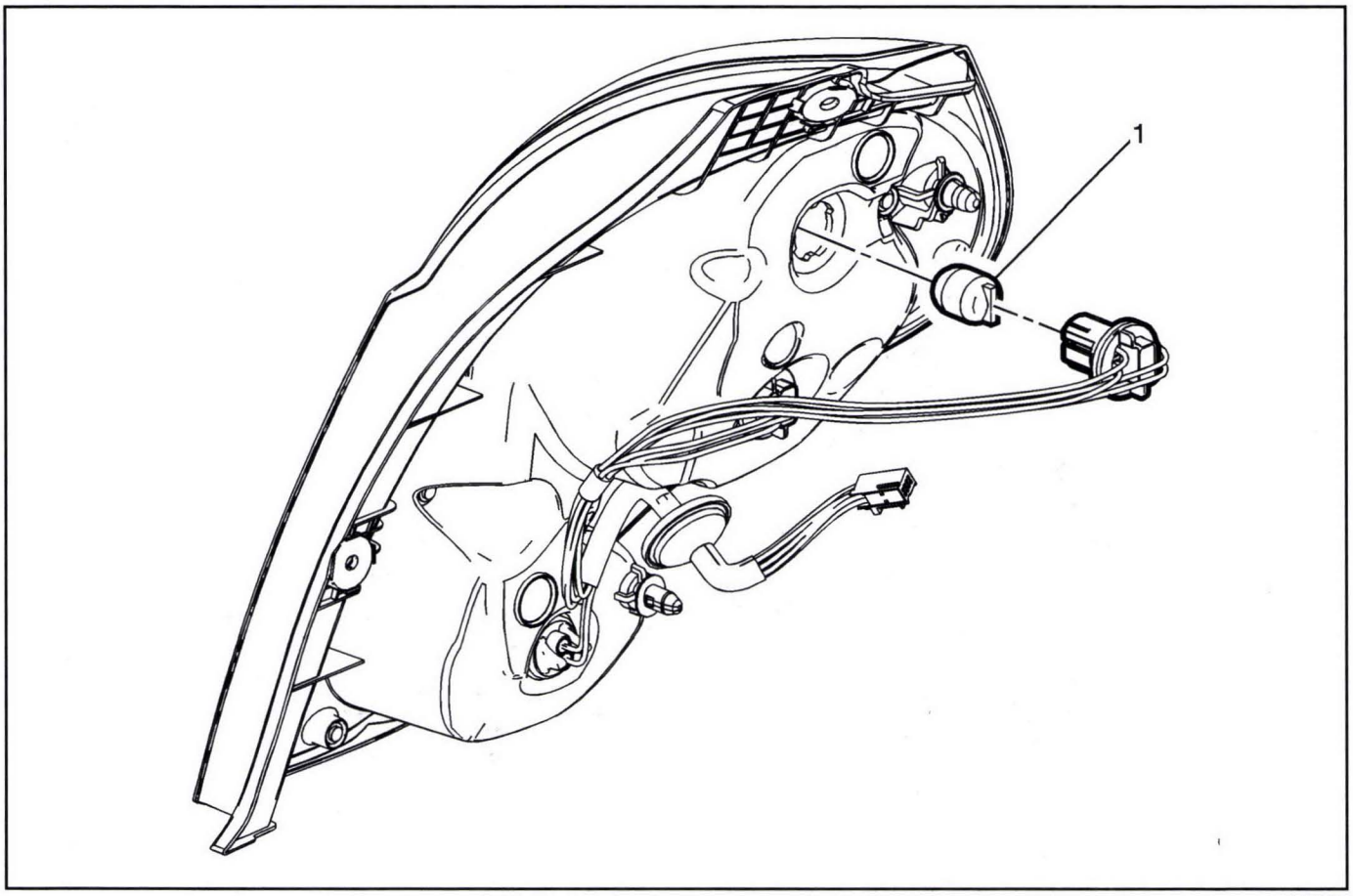


3136449

Rear Lamp Monitor Light Conductor Harness Replacement

Callout	Component Name
Preliminary Procedure Remove the tail lamp. Refer to *Tail Lamp Replacement on page 4-192*.	
1	Rear Lamp Monitor Light Conductor Harness **Procedure** Rotate all 3 rear lamp monitor light conductor harness sockets counterclockwise and pull from the tail lamp.

Stop and Tail Lamp Bulb Replacement (North America)

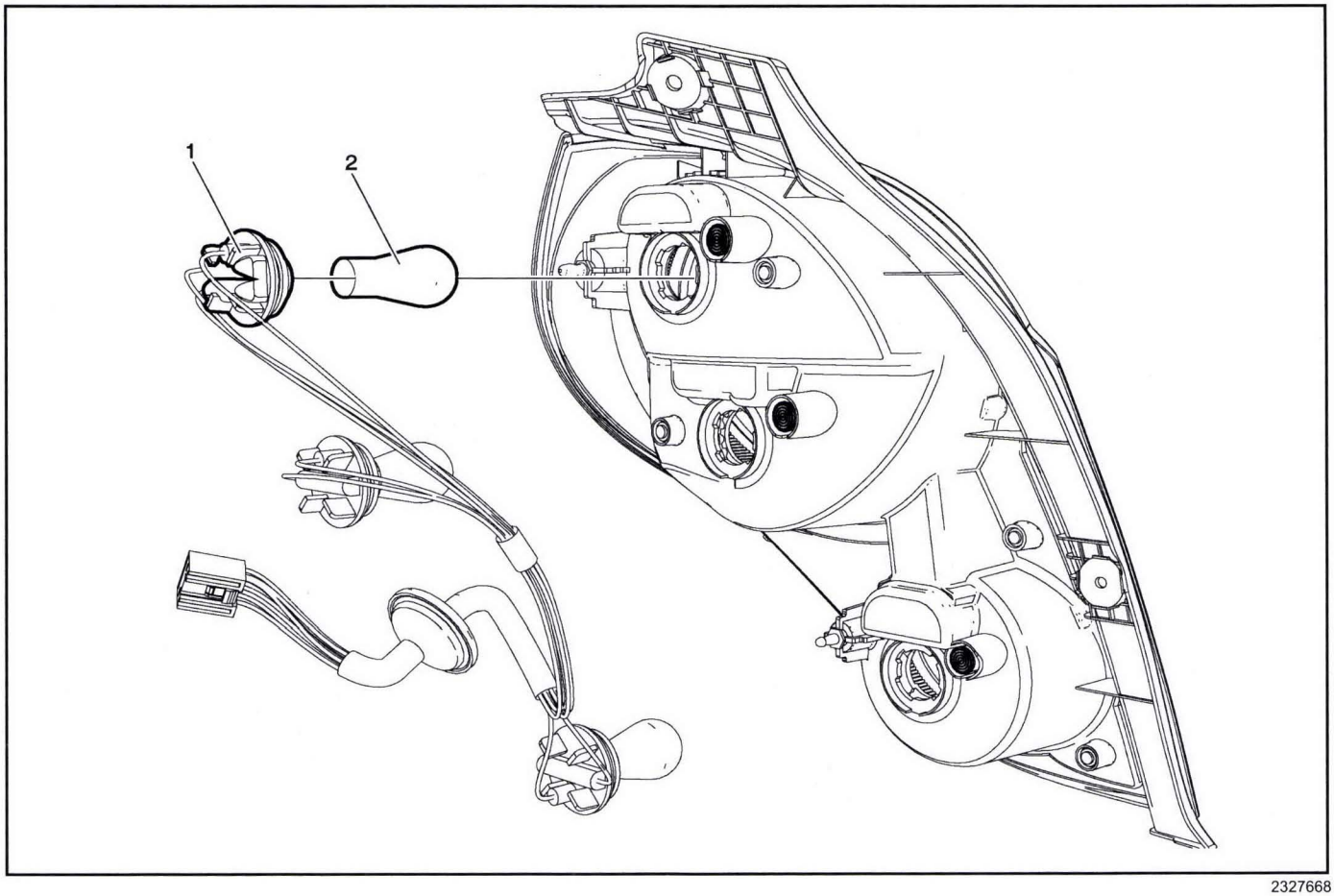


3153818

Stop and Tail Lamp Bulb Replacement (North America)

Callout	Component Name
Preliminary Procedure Remove the tail lamp. Refer to *Tail Lamp Replacement on page 4-192*.	
1	Stop and Tail Lamp Bulb **Procedure** 1. Turn the rear lamp monitor light conductor harness socket counterclockwise and pull from headlamp. 2. Pull the stop and tail lamp bulb straight from the rear lamp monitor light conductor harness socket.

Stop and Tail Lamp Bulb Replacement (Europe, Korea)

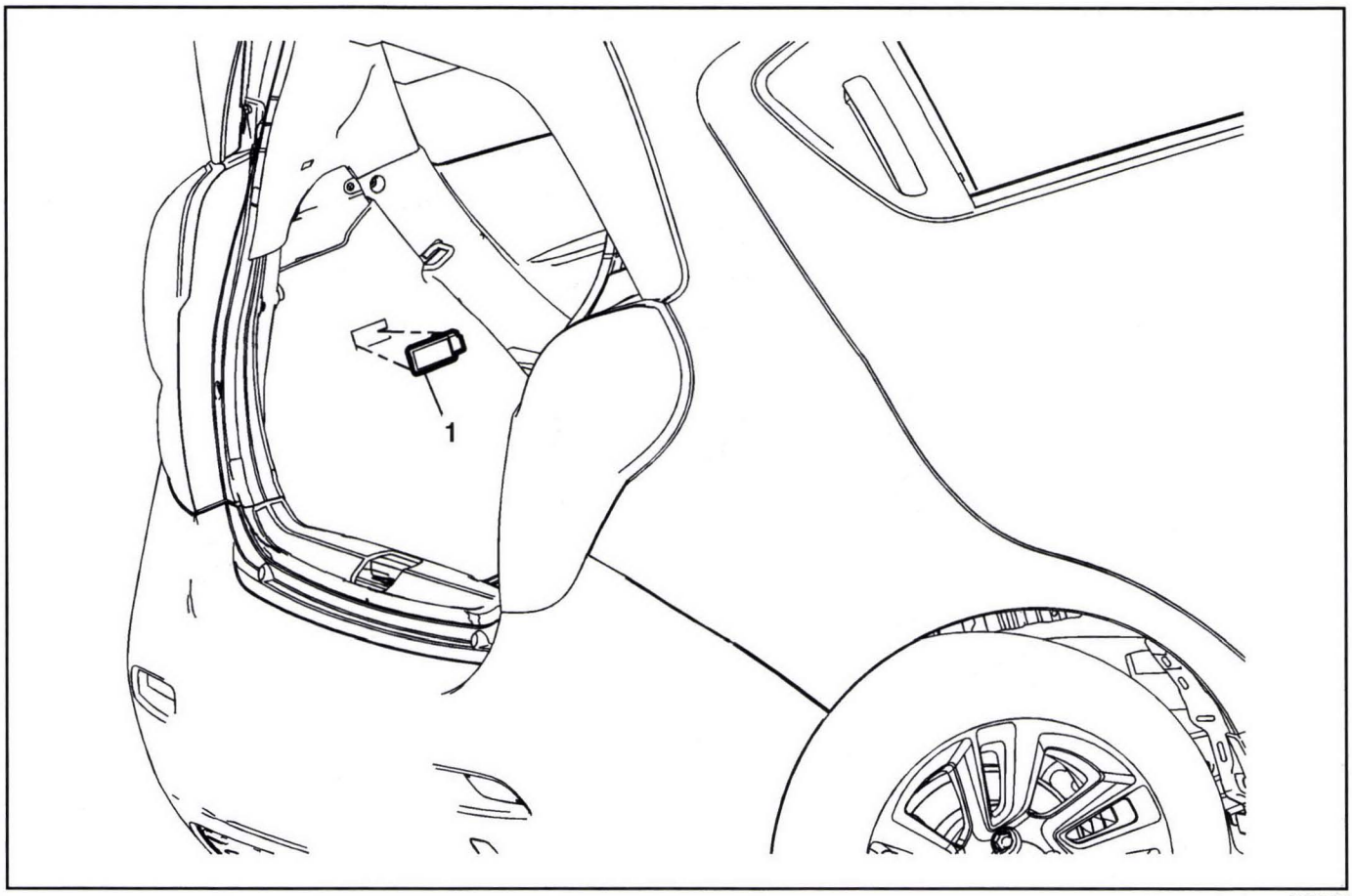


2327668

Stop and Tail Lamp Bulb Replacement (Europe, Korea)

Callout	Component Name
Preliminary Procedure Remove the tail lamp assembly. Refer to *Tail Lamp Replacement on page 4-192*.	
1	Tail Lamp Bulb Harness Socket ***Warning: Refer to Halogen Bulb Warning on page 0-5.*** **Tip:** Rotate the bulb socket from the tail lamp housing.
2	Tail Lamp Bulb **Procedure** Rotate the bulb from the lamp harness socket.

Rear Compartment Courtesy Lamp Replacement



3213933

Rear Compartment Courtesy Lamp Replacement

Callout	Component Name
1	Rear Compartment Courtesy Lamp **Procedure** 1. Remove the rear compartment lamp using a small fat bladed tool to release the retaining tabs. 2. Disconnect the electrical connector.

Description and Operation

Exterior Lighting Systems Description and Operation

Exterior Lamps

The exterior lighting system consist of the following lamps if equipped:

- Backup lamps
- Hazard warning lamps
- Headlamps
- Park, tail and license lamps
- Rear fog lamps
- Repeater lamps
- Stop lamps
- Turn signal lamps

Low Beam Headlamps

The body control module (BCM) monitors two signal circuits from the headlamp switch. With the headlamp switch in the PARK position, the headlamp switch park lamps ON signal circuit is grounded, indicating that the park lamps have been requested. When the headlamp switch is placed in the HEADLAMP position, both the headlamp switch park lamps ON signal circuit and the headlamp switch headlamps ON signal circuit are grounded. The BCM responds to the inputs by illuminating the park lamps and headlamps. When the low beam headlamps are requested, the BCM applies B+ to both low beam headlamp control circuits illuminating the low beam headlamps.

The BCM will also command the low beam headlamps ON during daylight conditions when the following conditions are met:

- Headlamp switch in the AUTO position
- Windshield wipers ON
- Vehicle in any gear but PARK

When the BCM commands the low beam headlamps ON, the operator will notice the interior backlighting for the instrument cluster and the various other switches dim to the level of brightness selected by the instrument panel dimmer switch.

High Beam Headlamps

When the low beam headlamps are ON and the turn signal/multifunction switch is placed in the high beam position, ground is applied to the BCM through the high beam signal circuit. The BCM responds to the high beam request by applying ground to the high beam relay control circuit which energizes the high beam relay. With the high beam relay energized, the switch contacts close allowing battery voltage to flow through the left and right high beam fuses to the high beam control circuits illuminating the left and right high beam headlamps.

Daytime Running Lamps (DRL)

The daytime running lamps (DRL) will illuminate the right and left low beam headlamps continuously. The DRLs will operate when the following conditions are met:

- The vehicle ON/OFF switch is in the Service Mode or ON position
- The shift lever is out of the PARK position
- The low and high beam headlamps are OFF

With the headlamp switch is in the off position the BCM will command the low beam headlamps ON. The low beam headlamps are the designated DRL's. Any function or condition that turns on the headlamps will cancel DRL operation.

Flash to Pass (FTP)

When the turn signal/multifunction switch is momentarily placed in the flash to pass (FTP) position, ground is applied from to the turn signal/multifunction switch. The turn signal/multifunction switch applies ground to the body control module (BCM) through the FTP switch signal circuit. The BCM then applies ground to the high beam relay control circuit. This energizes the high beam relay, closing the switch side contacts of the high beam relay, applying battery voltage to the left and right high beam fuses. Battery voltage is applied from the high beam fuses through the high beam control circuit to the high beam headlamp assemblies. This causes the high beam headlamps to illuminate at full brightness momentarily.

Rear Fog Lamps

The rear fog lamp switch signal circuit is grounded through a resistor momentarily by pressing the rear fog lamp switch. The body control module (BCM) energizes the rear fog lamp supply voltage circuit which illuminates the rear fog lamp. With the rear fog lamp switch activated the BCM sends a message via serial data to the instrument cluster requesting the instrument cluster to illuminate the rear fog indicator.

Hazard Warning Lamps

The hazard warning lamps may be activated in any power mode. The hazard warning switch signal circuit is momentarily grounded when the hazard warning switch is pressed. The body control module (BCM) responds to the hazard warning switch signal input by supplying battery voltage to all four turn signal lamps in an ON and OFF duty cycle. When the hazard warning switch is activated, the BCM sends a serial data message to the instrument cluster requesting both turn signal indicators to be cycled ON and OFF.

The instrument panel dimmer switch controls are used to increase and decrease the brightness of the interior backlighting components. When the instrument panel dimmer switch is placed in a desired brightness position, the body control module (BCM) receives a signal from the instrument panel dimmer switch and responds by applying a pulse width modulated (PWM) voltage to the hazard switch LED backlighting control circuit illuminating the LED to the desired level of brightness.

Park, Tail, and License Lamps

When the headlamp switch is placed in the HEAD or PARK position, ground is applied to the park lamp switch ON signal circuit to the body control module (BCM). The BCM responds by applying voltage to the park lamps, tail lamps, and license lamps control circuits illuminating the park, tail, and license lamps.

Stop Lamps

The brake pedal position (BPP) sensor is used to sense the action of the driver application of the brake pedal. The BPP sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5-volt reference voltage to the BPP sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the left and right stop lamp control circuits as well as the center high mounted stop lamp (CHMSL) control circuit illuminating the left and right stop lamps and the CHMSL.

Turn Signal Lamps

Ground is applied at all times to the turn signal/ multifunction switch. The turn signal lamps may only be activated with the vehicle ON/OFF switch in the Service Mode or ON positions. When the turn signal/ multifunction switch is placed in either the TURN RIGHT or TURN LEFT position, ground is applied to the body control module (BCM) through either the right turn or left turn signal switch signal circuit. The BCM responds to the turn signal switch input by applying a pulsating voltage to the front and rear turn signal lamps through there respective control circuits. When a turn signal request is received by the BCM, a serial data message is sent to the instrument cluster requesting the respective turn signal indicator be pulsed ON and OFF.

Backup Lamps

With the vehicle ON and the transmission in the reverse position, the transmission control module (TCM) sends a serial data message to the body control module (BCM). The message indicates that the gear selector is in the reverse position. The BCM applies battery voltage to the backup lamps control circuit illuminating the backup lamps. Once the driver moves the gear selector out of the reverse position, a message is sent by the TCM via serial data requesting the BCM to

remove battery voltage from the backup lamps control circuit. The vehicle must be ON for the backup lamps to operate.

Battery Run Down Protection/ Inadvertent Power

To provide battery run down protection, the exterior lamps will be deactivated automatically under certain conditions. The BCM monitors the state of the headlamp switch. If the park or headlamp switch is ON when the vehicle ON/OFF switch is placed in either the Service Mode or ON position and then placed in the OFF position, the BCM initiates a 10 min timer. At the end of the 10 min, the BCM will turn off the control power output to the park lamp controls as well as the headlamp relay coils, deactivating the exterior lamps. This feature will be cancelled if any power mode other than OFF becomes active. The BCM will disable battery run down protection if any of the following conditions exist. The park or headlamp switch is placed in the ON to OFF position, and back to the ON position during battery run down protection. The BCM determined that the park or headlamp switch was not active when the vehicle ON/OFF switch was turned OFF.

Interior Lighting Systems Description and Operation

Interior Lamps

The interior lighting consist of two groups. This first group includes lamps that may not be dimmed.

- Dome lamp/reading lamps
- Rear compartment courtesy lamp

Dome Lamp

When any door is opened, the associated door jamb switch closes providing a door open input to the body control module (BCM). The BCM responds by applying battery positive voltage to the dome lamp control circuit illuminating the dome lamp. The dome lamp will turn OFF immediately if the vehicle ON/OFF switch is turned to the ON position or approximately 20 seconds after all doors are closed. The dome lamp will normally turn OFF using the theater dimming feature when controlled by the BCM. If the operator inadvertently leaves any interior lamp ON, the BCM will turn all interior lamps OFF after 10 minutes has passed since any switch activation has been detected by the BCM.

Keyless Entry Interior Illumination

When the operator uses the keyless entry transmitter in order to unlock the doors, the BCM receives a door-unlock signal. The BCM must receive inputs from various systems that indicate that the vehicle ON/OFF switch is OFF, the courtesy lamp switch is OFF, and all doors are closed before the BCM will activate the interior lamps. The courtesy lamps will remain ON for 20 seconds after the door is closed. The BCM will turn off the courtesy lamps OFF through the theater dimming feature. If the door locks are activated to the LOCK position, or if the vehicle ON/OFF switch is turned to either the Service Mode or ON position, the courtesy lamps will turn OFF immediately.

Rear Compartment Courtesy Lamp

The BCM provides battery positive voltage to the rear compartment courtesy lamp. When the rear compartment is opened, the rear compartment latch opens providing a rear compartment open input to the BCM. The BCM responds by applying battery positive voltage to the rear compartment lamp control circuit illuminating the rear compartment lamp.

Reading Lamp

The inadvertent power supply voltage circuit from the BCM provides battery positive voltage the reading lamp. When the reading lamp switch is activated, the switch contacts close providing a path to ground and the reading lamp illuminates. If the operator inadvertently leaves a reading lamp ON, the BCM will turn all interior lamps OFF after 10 minutes has passed since any switch activation has been detected by the BCM.

Battery Rundown Protection/ Inadvertent Power

The BCM inadvertent power supply voltage circuit provides battery positive voltage to all of the interior lamps. In the event that any of these lamps were to remain illuminated for a period of more than 10 minutes with the vehicle ON/OFF switch in the OFF position, the BCM will deactivate the inadvertent power supply voltage circuit to prevent total battery discharge.

Interior Lamps Dimming

The second group includes lamps which may be dimmed.

- Door lock switch – driver
- Door lock switch – passenger
- Drive mode select switch
- Hazard warning switch
- HVAC control head assembly
- Instrument cluster
- Instrument panel dimmer switch
- Liftgate unlatch switch
- Multifunction switch – center console
- Park brake control switch
- Radio
- Seat heating switch – driver
- Seat heating switch – passenger
- Steering wheel controls switch – right
- Steering wheel controls switch – left
- Transmission shift lever position indicator
- Vehicle stability control switch

When the headlamp switch is placed in the PARK or HEAD position, the park lamp switch signal circuit provides an input to the body control module (BCM). The BCM responds by applying voltage to the park lamps as well as the dimming control circuits illuminating all components with interior backlighting. All LED and incandescent backlighting turns ON at the dimming level indicated by the instrument panel dimmer switch. The instrument panel dimmer switch is a potentiometer type switch used to accomplish dimming controls. The instrument panel dimmer switch

contains a battery positive voltage reference circuit, a signal circuit, and a low reference circuit from the BCM. When the instrument panel dimmer switch is held in the decrease brightness position, the BCM receives a low voltage signal via the instrument panel dimmer switch signal circuit. The BCM responds by decreasing the brightness of all interior backlighting by decreasing the voltage supplied to the backlighting components via the dimming control circuits. When the instrument panel dimmer switch is held in the increase brightness position, the BCM receives a high voltage signal via the instrument panel dimmer switch signal circuit. The BCM responds by increasing the brightness of all interior backlighting by increasing the voltage supplied to the backlighting components via the dimming control circuits.

Mirrors

Specifications

Fastener Tightening Specifications

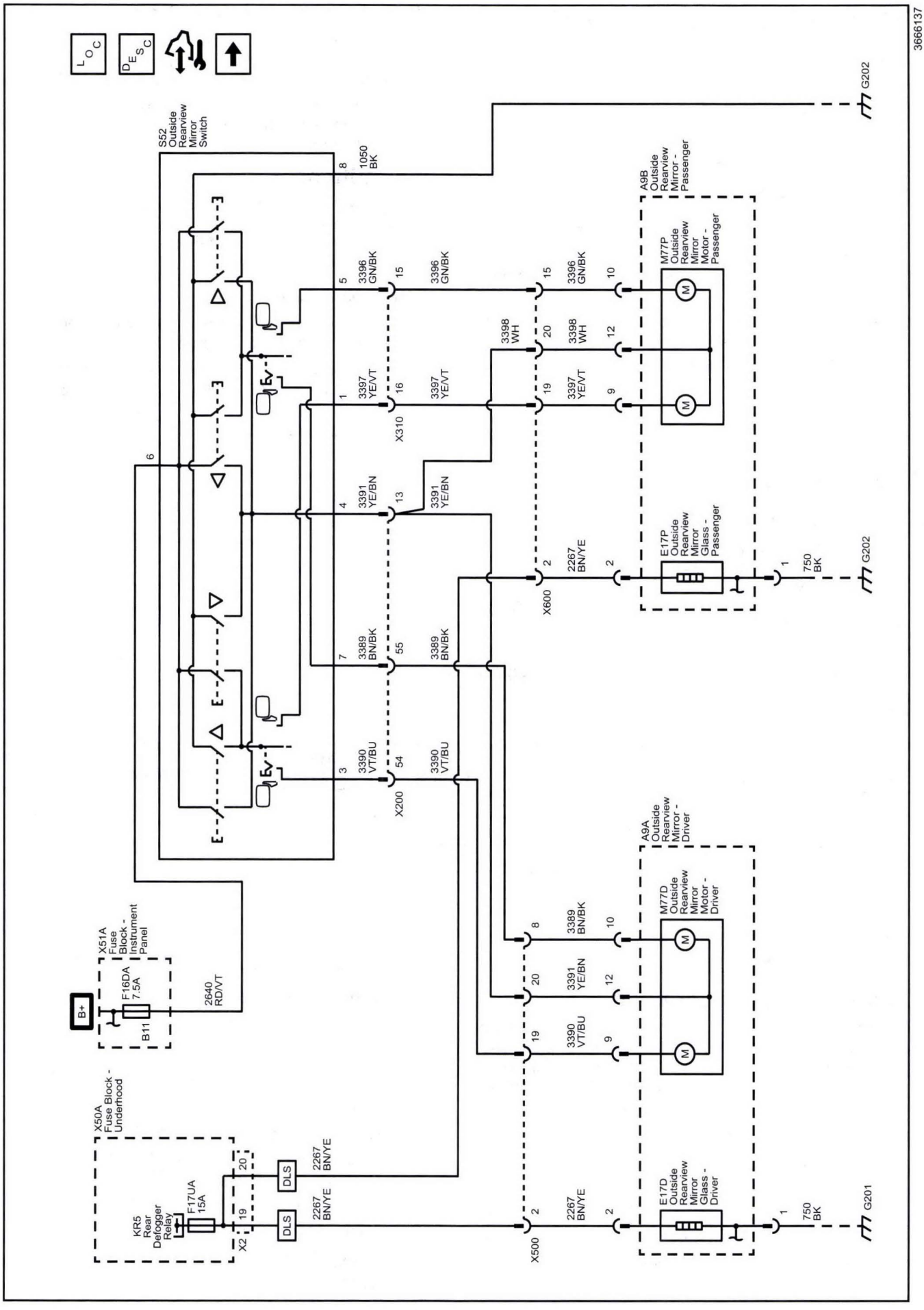
Application	Specification	
	Metric	English
Inside Rearview Mirror Screw	2 N•m	18 lb in
Outside Rearview Mirror Fastener	10 N•m	89 lb in
Outside Rearview Mirror Housing Fastener	5 N•m	44 lb in
Outside Rearview Mirror Inner Actuator Fastener	5 N•m	44 lb in

Adhesives, Fluids, Lubricants, and Sealers

Application	Type of Material	GM Part Number
Inside Mirror Adhesive Kit	Adhesive	Refer to Electronic Parts Catalog

Schematic and Routing Diagrams

Outside Rearview Mirror Schematics (Outside Rearview Mirrors)



Outside Rearview Mirror Schematics (Outside Rearview Mirrors)

Diagnostic Information and Procedures

Symptoms - Mirrors

Note: The following steps must be completed before using the symptom tables.

1. Perform the *Diagnostic System Check - Vehicle on page 6-91* before using the Symptom Tables in order to verify that all of the following are true:
   - There are no DTCs set.
   - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to *Outside Mirror Description and Operation on page 4-216*.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the system. Refer to *Checking Aftermarket Accessories on page 11-871*.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to *Testing for Intermittent Conditions and Poor Connections on page 11-877*.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- *Heated Mirrors Malfunction on page 4-204*
- *Power Mirror Malfunction on page 4-206*

Heated Mirrors Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Heated Mirror Element Control	2	1	3	—
Driver Outside Rearview Mirror Ground	—	1	—	—
Right Heated Mirror Element Control	2	1	3	—
Passenger Outside Rearview Mirror Ground	—	1	—	—

1. Single Heated Mirror Inoperative
2. Both Heated Mirrors Inoperative
3. Heated Mirrors Always On

Circuit/System Description

The rear defogger relay supplies voltage to the outside rearview mirror heater elements based on the current state of the rear window defogger. The relay supplies B + through the driver/passenger mirror heating element control circuit when a request is seen.

Reference Information

Schematic Reference

Outside Rearview Mirror Schematics on page 4-203

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Outside Mirror Description and Operation on page 4-216

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the E18 Rear Defogger Grid turns ON and OFF when commanding the Rear Defogger On and Off with a scan tool.

⇒ **If the E18 Rear Defogger Grid does not turn ON or OFF**

Refer to *Rear Window Defogger Malfunction on page 4-10*.

⇓ **If the E18 Rear Defogger Grid turns ON and OFF**

3. Verify the E17D Outside Rearview Mirror Glass-Driver and the E17P Outside Rearview Mirror Glass-Passenger become warm when commanding the Rear Defogger On with a scan tool.

⇒ **If the E17D Outside Rearview Mirror Glass-Driver and the E17P Outside Rearview Mirror Glass-Passenger do not become warm**

Refer to Circuit/System Testing.

⇓ **If the E17D Outside Rearview Mirror Glass-Driver and the E17P Outside Rearview Mirror Glass-Passenger become warm**

4. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate A9 Outside Rearview Mirror. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode, connect a test lamp between the control circuit terminal 2 and the ground circuit terminal 1.
4. Verify the test lamp turns ON and OFF when commanding the Rear Defogger On and Off with a scan tool.

⇒ **If the test lamp is always OFF**

4.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the X50A Fuse Block-Underhood.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the X50A Fuse Block-Underhood.

⇓ **If the test lamp is always ON**

4.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the X50A Fuse Block-Underhood, Vehicle in Service Mode.

4.2. Test for less than 1 V between the control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the X50A Fuse Block-Underhood

⇓ **If the test lamp turns ON and OFF**

5. Test or replace the E17 Outside Rearview Mirror Glass.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Outside Rearview Mirror Glass Replacement on page 4-213

Power Mirror Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Outside Rearview Mirror Switch B+	1	1	—	—
Driver Mirror Motor Horizontal Control	1	2	2	—
Driver Mirror Motor Vertical Control	1	2	2	—
Passenger Mirror Motor Horizontal Control	1	3	3	—
Passenger Mirror Motor Vertical Control	1	3	3	—
Outside Rearview Mirror Switch Ground	—	1	—	—
1. Both Outside Power Mirrors Inoperative 2. Driver Outside Power Mirror Malfunction 3. Passenger Outside Power Mirror Malfunction				

Circuit/System Description

The outside rearview mirror switch controls the outside rearview mirrors based on the position of the mirror selector switch and which movement position is selected. The outside rearview mirror switch has four positions: up, down, left, and right. B+ is applied to the switch from the power mirror fuse and when a movement position switch is selected, voltage is sent to the commanded mirror via a mirror control circuit. The opposite mirror control circuit acts as a ground circuit for the bi-directional mirror motor. Ground is the applied through the switch.

Reference Information

Schematic Reference

Outside Rearview Mirror Schematics on page 4-203

Connector End View Reference

Component Connector End Views on page 11-455
Inline Harness Connector End Views on page 11-761

Description and Operation

Outside Mirror Description and Operation on page 4-216

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Circuit/System Verification

1. Verify the mirror glass of the A9A Outside Rearview Mirror-Driver and the A9B Outside Rearview Mirror-Passenger move UP, DOWN, LEFT and RIGHT with the S52 Outside Rearview Mirror Switch.

⇒ **If both outside mirror glasses do not move**

Refer to Circuit/System Testing — Both Outside Rearview Mirrors Inoperative.

⇒ **If the driver outside mirror glass does not move UP, DOWN, LEFT or RIGHT**

Refer to Circuit/System Testing — Driver Outside Mirror Movement Malfunction.

⇒ **If the passenger outside mirror glass does not move UP, DOWN, LEFT or RIGHT**

Refer to Circuit/System Testing — Passenger Outside Mirror Movement Malfunction.

⇓ **If the mirror glass of the A9A Outside Rearview Mirror-Driver and the A9B Outside Rearview Mirror-Passenger move UP, DOWN, LEFT and RIGHT**

2. All OK.

Circuit/System Testing

Both Outside Rearview Mirrors Inoperative

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S52 Outside Rearview Mirror Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 8 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Verify a test lamp illuminates between the B+ circuit terminal 6 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

3.1. Vehicle OFF.

3.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

3.1. Vehicle OFF.

3.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

3.3. Test for infinite resistance between each of the control circuit terminals listed below and ground:

- Control circuit terminal 1
- Control circuit terminal 3
- Control circuit terminal 4
- Control circuit terminal 5
- Control circuit terminal 7

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the M77 Outside Rearview Mirror Motor.

⇓ **If the test lamp illuminates**

4. Test or replace the S52 Outside Rearview Mirror Switch.

Driver Outside Mirror Movement Malfunction

1. Vehicle OFF, disconnect the X500 inline harness connector at the A9A Outside Rearview Mirror-Driver, Vehicle in Service Mode
2. Connect a test lamp between the control circuit terminal 19 and control circuit terminal 20.
3. Verify the test lamp turns ON when commanding the UP and DOWN states with the S52 Outside Rearview Mirror Switch.

⇒ **If the test lamp remains OFF during either of the commands**

3.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S52 Outside Rearview Mirror Switch.

3.2. Test for infinite resistance between each control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

3.3. Test for less than 2 Ω in each control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the S52 Outside Rearview Mirror Switch.

⇒ **If the test lamp is always ON**

3.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S52 Outside Rearview Mirror Switch, Vehicle in Service Mode.

3.2. Test for less than 1 V between each control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, test or replace the S52 Outside Rearview Mirror Switch.

⇓ **If the test lamp turns ON during each of the commands**

4. Connect a test lamp between the control circuit terminal 8 and control circuit terminal 20.
5. Verify the test lamp turns ON when commanding the LEFT and RIGHT states with the S52 Outside Rearview Mirror Switch.

⇒ **If the test lamp remains OFF during either of the commands**

5.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S52 Outside Rearview Mirror Switch.

5.2. Test for infinite resistance between each control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

5.3. Test for less than 2 Ω in each control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the S52 Outside Rearview Mirror Switch.

⇒ **If the test lamp is always ON**

5.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S52 Outside Rearview Mirror Switch, Vehicle in Service Mode.

5.2. Test for less than 1 V between each control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, test or replace the S52 Outside Rearview Mirror Switch

⇓ **If the test lamp turns ON during each of the commands**

6. Test or replace the M77D Outside Rearview Mirror Motor-Driver.

Passenger Outside Mirror Movement Malfunction

1. Vehicle OFF, disconnect the X600 inline harness connector at the A9B Outside Rearview Mirror-Passenger, Vehicle in Service Mode.
2. Connect a test lamp between the control circuit terminal 19 and control circuit terminal 20.
3. Verify the test lamp turns ON when commanding the UP and DOWN states with the S52 Outside Rearview Mirror Switch.

⇒ **If the test lamp remains OFF during either of the commands**

3.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S52 Outside Rearview Mirror Switch.

3.2. Test for infinite resistance between each control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

3.3. Test for less than 2 Ω in each control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the S52 Outside Rearview Mirror Switch.

⇒ **If the test lamp is always ON**

3.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S52 Outside Rearview Mirror Switch, Vehicle in Service Mode.

3.2. Test for less than 1 V between each control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, test or replace the S52 Outside Rearview Mirror Switch

⇓ **If the test lamp turns ON during each of the commands**

4. Connect a test lamp between the control circuit terminal 15 and control circuit terminal 20.
5. Verify the test lamp turns ON when commanding the LEFT and RIGHT states with the S52 Outside Rearview Mirror Switch.

⇒ **If the test lamp remains OFF during either of the commands**

5.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S52 Outside Rearview Mirror Switch.

5.2. Test for infinite resistance between each control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

5.3. Test for less than 2 Ω in each control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the S52 Outside Rearview Mirror Switch.

⇒ **If the test lamp is always ON**

5.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S52 Outside Rearview Mirror Switch, Vehicle in Service Mode.

5.2. Test for less than 1 V between each control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, test or replace the S52 Outside Rearview Mirror Switch.

⇓ **If the test lamp turns ON during each of the commands**

6. Test or replace the M77P Outside Rearview Mirror Motor-Passenger.

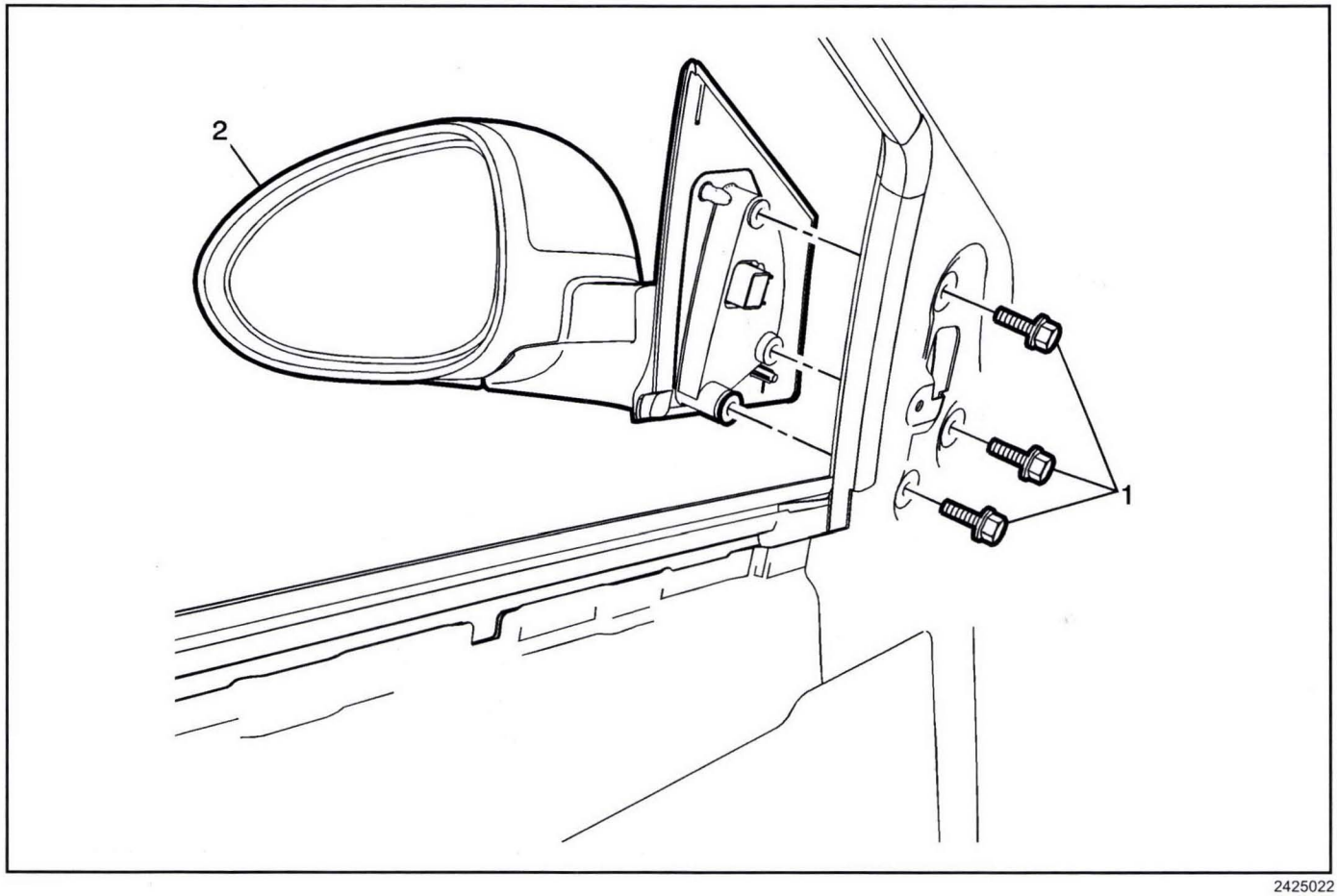
Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Outside Rearview Mirror Remote Control Switch Replacement on page 4-212*
- *Outside Rearview Mirror Inner Actuator Replacement on page 4-213*

Repair Instructions

Outside Rearview Mirror Replacement



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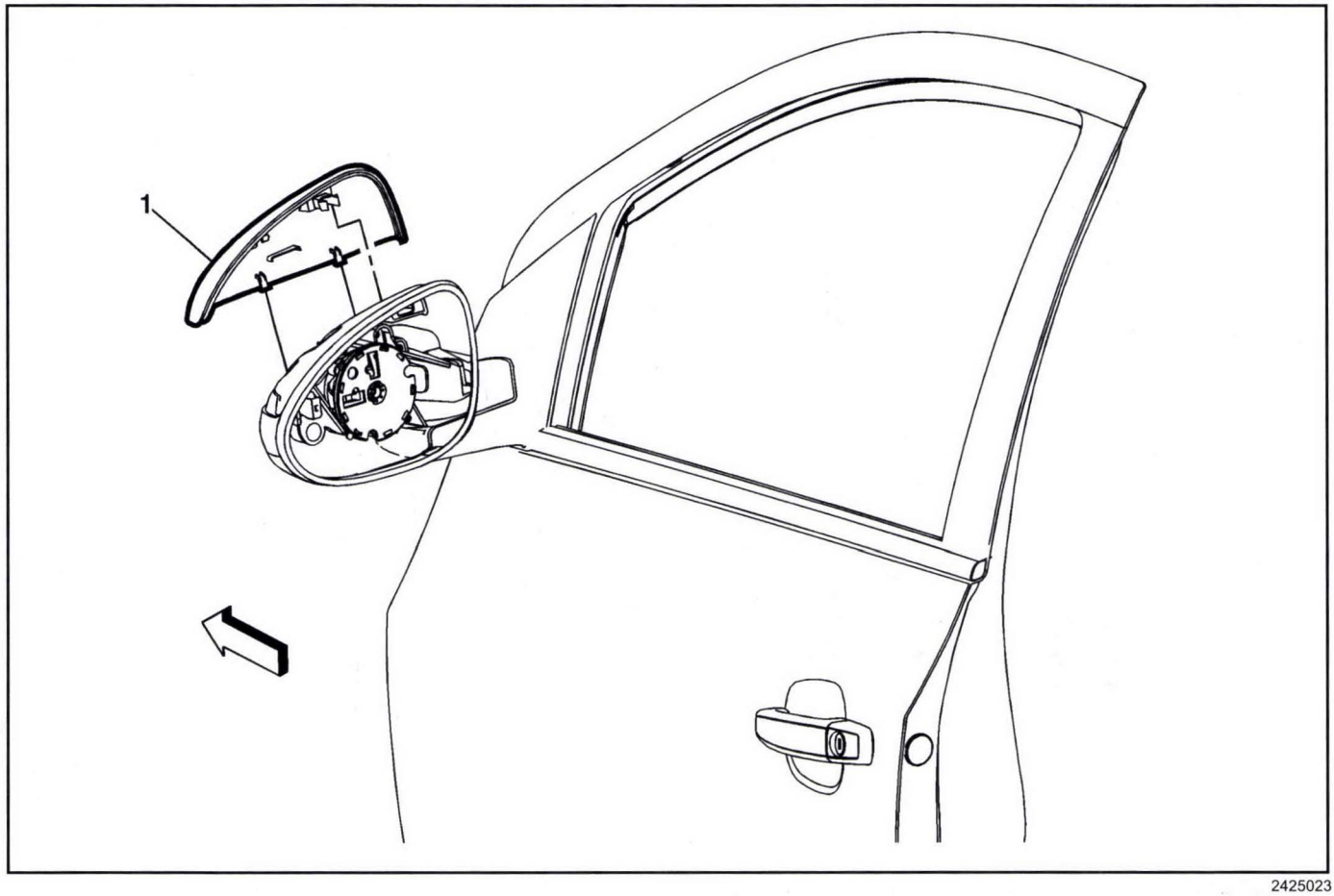
Outside Rearview Mirror Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the front side door upper front trim panel. Refer to *Front Side Door Upper Trim Panel Replacement on page 2-52*. 2. Remove the outside rearview mirror bolt access hole on the front side door trim.	
1	Outside Rearview Mirror Fastener (Qty: 3) **Caution:** Refer to *Fastener Caution on page 0-8*. **Procedure** Disconnect the electrical connector. **Tighten** 10 N•m (89 lb in)
2	Outside Rearview Mirror **Procedure** Inspect the outside mirror for proper operation before installing the door trim panel.

Outside Rearview Mirror Housing Cover Replacement (without Side Turn Signal Lamp)



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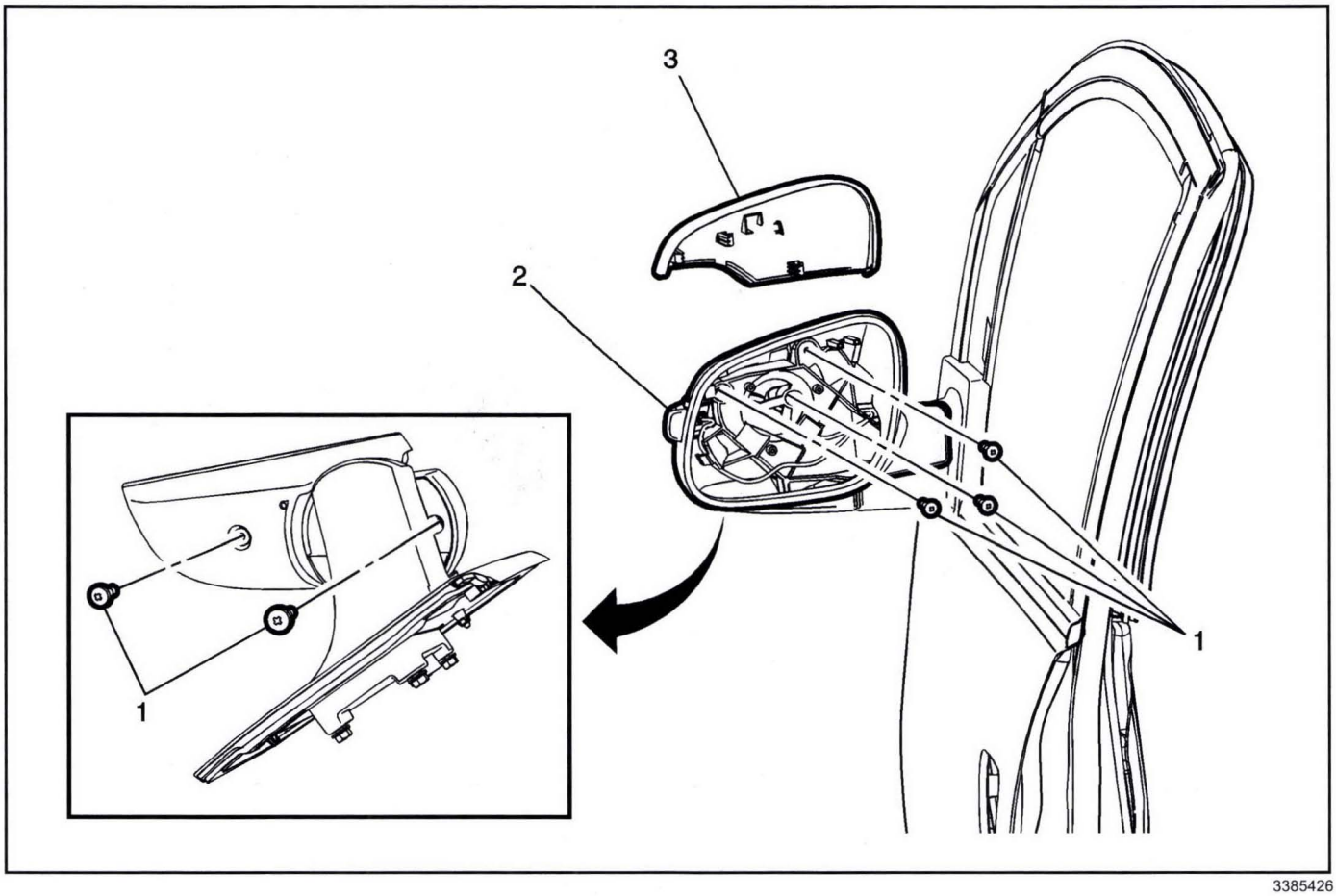
Outside Rearview Mirror Housing Cover Replacement (without Side Turn Signal Lamp)

Callout	Component Name
Preliminary Procedures Remove the outside rearview mirror glass. Refer to *Outside Rearview Mirror Glass Replacement on page 4-213*.	
1	Outside Rearview Mirror Housing Cover **Note:** 1. After the mirror glass has been removed the retainers can be accessed to release. 2. Align the housing cover with the slots in the mirror housing, push downward locking retainers in place. 3. Inspect the outside mirror for proper operation.

Outside Rearview Mirror Housing Cover Replacement (with Side Turn Signal Lamp)



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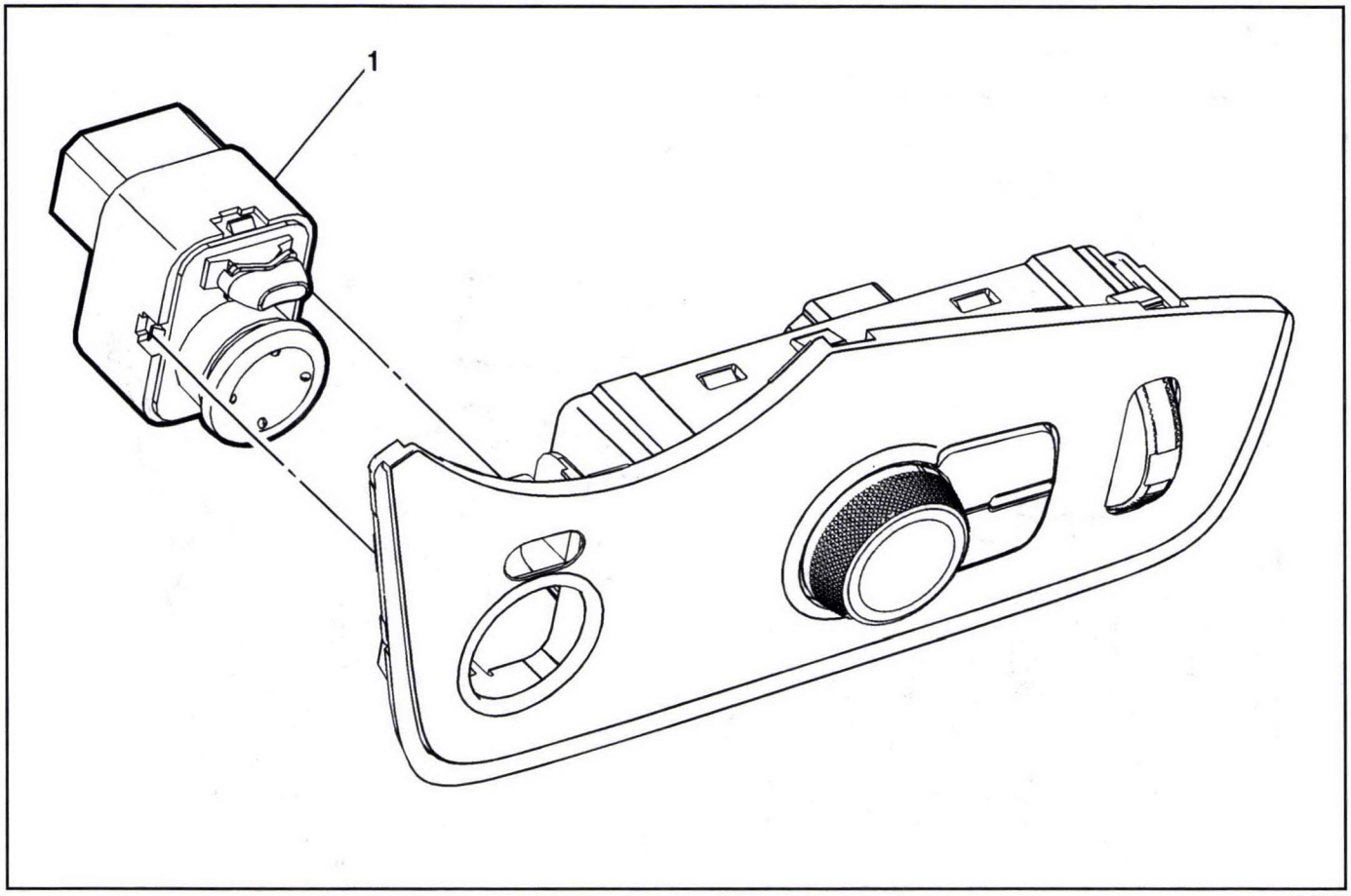
Outside Rearview Mirror Housing Cover Replacement (with Side Turn Signal Lamp)

Callout	Component Name
Preliminary Procedures Remove the outside rearview mirror inner actuator. Refer to *Outside Rearview Mirror Inner Actuator Replacement on page 4-213*.	
1	Outside Rearview Mirror Housing Screw (Qty: 5) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 2 N•m (18 lb in)
2	Outside Rearview Mirror Housing
3	Outside Rearview Mirror Housing Cover 1. Release the mirror housing cover taps from the mirror housing. 2. After the removal of the mirror housing cover, visually inspect the cover taps for breaking before installation. 3. If the cover taps are broken, replace with new cover. **Note:** • To access the mirror housing cover taps easily, loosen the mirror housing screws and then move the mirror housing in every direction. • The mirror housing cannot be removed from the outside mirror assembly.

Outside Rearview Mirror Remote Control Switch Replacement



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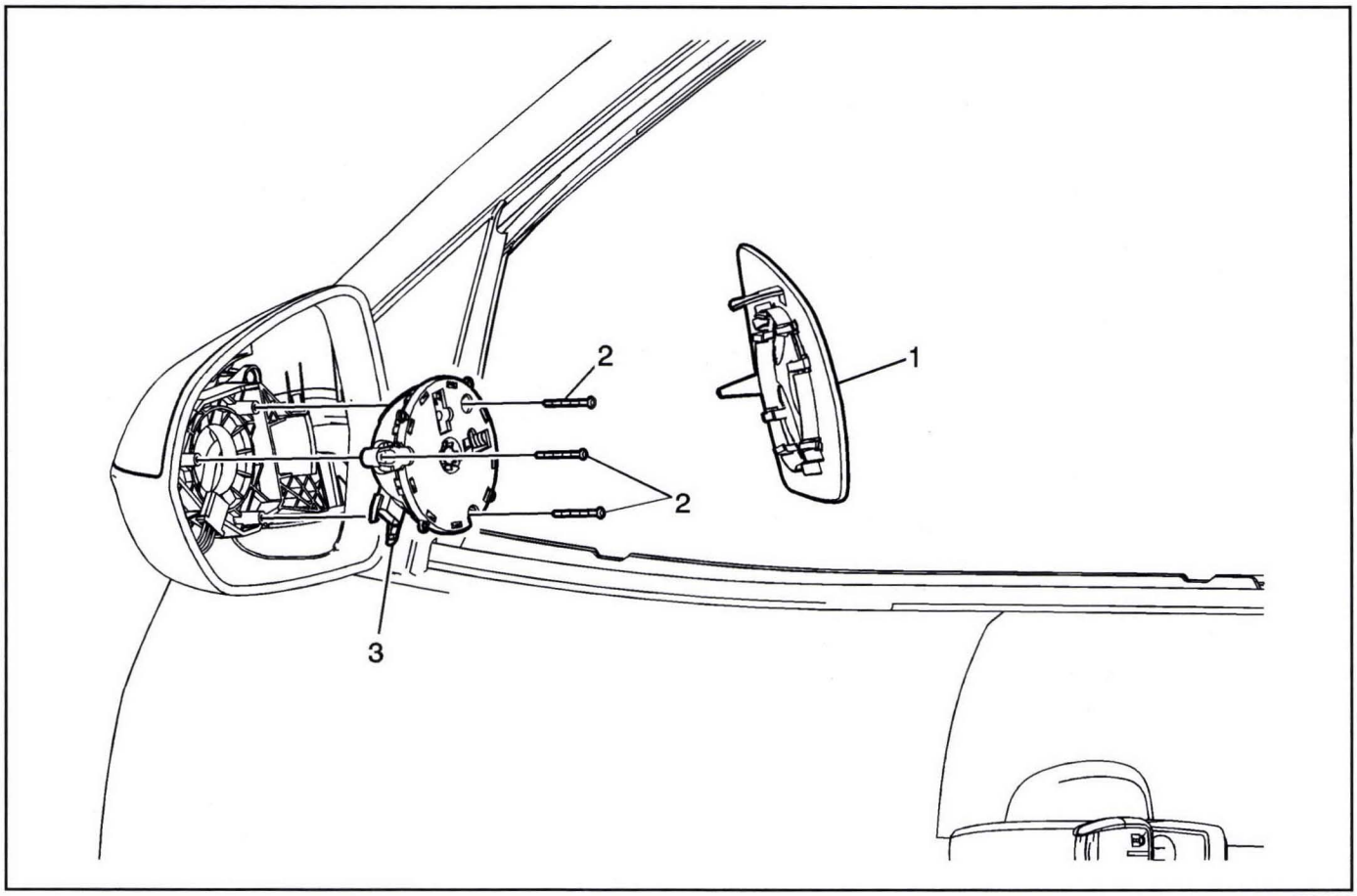
Outside Rearview Mirror Remote Control Switch Replacement

Callout	Component Name
Preliminary Procedure Remove the instrument panel trim plate applique – left side. Refer to *Instrument Panel Trim Plate Applique Replacement - Left Side on page 2-24*.	
1	Outside Rearview Mirror Remote Control Switch **Procedure** 1. Disconnect the electrical connections. 2. Release tabs on switch to remove from the applique.

Outside Rearview Mirror Inner Actuator Replacement



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Outside Rearview Mirror Inner Actuator Replacement

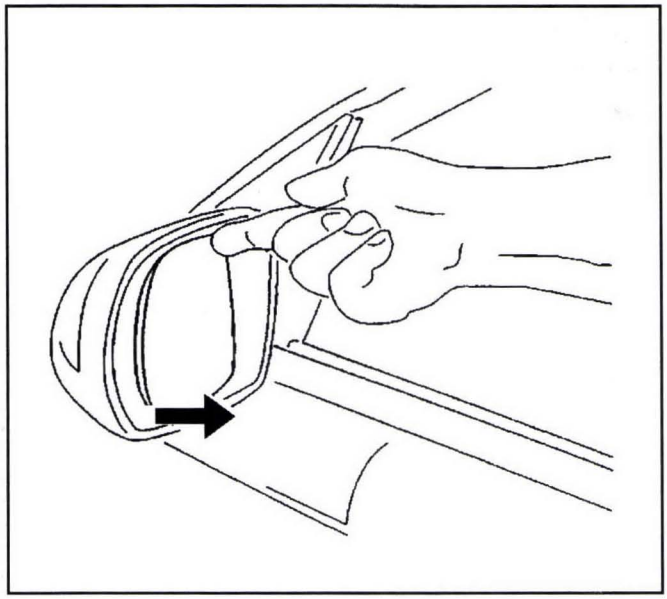
Callout	Component Name
1	Outside Rearview Mirror Glass **Procedure** Remove the outside rearview mirror glass. Refer to *Outside Rearview Mirror Glass Replacement on page 4-213*.
2	Outside Rearview Mirror Inner Actuator Fastener (Qty: 3) **Caution:** Refer to *Fastener Caution on page 0-8*. **Procedure** Disconnect the outside mirror inner actuator electrical connector. **Tighten** 5 N•m (44 lb in)
3	Outside Rearview Mirror Inner Actuator **Note:** Inspect the outside mirror for proper operation.

Outside Rearview Mirror Glass Replacement

Removal Procedure

Warning: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury.

1. Place masking tape over the mirror glass.



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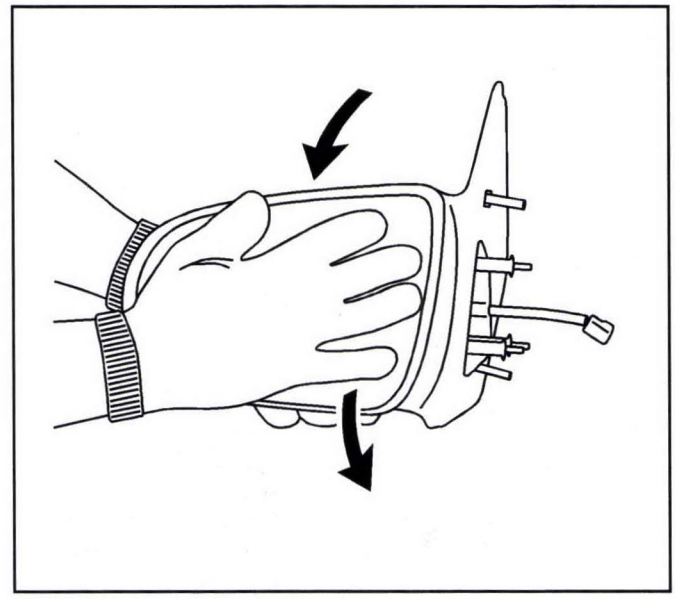
2. Carefully push the outside rearview mirror glass upward and into the right corner of the mirror housing, allowing access to the bottom edge.
3. Grasp the bottom edge of the mirror glass firmly, lift it up and pull rearward until the mirror glass releases the motor ring.

Installation Procedure



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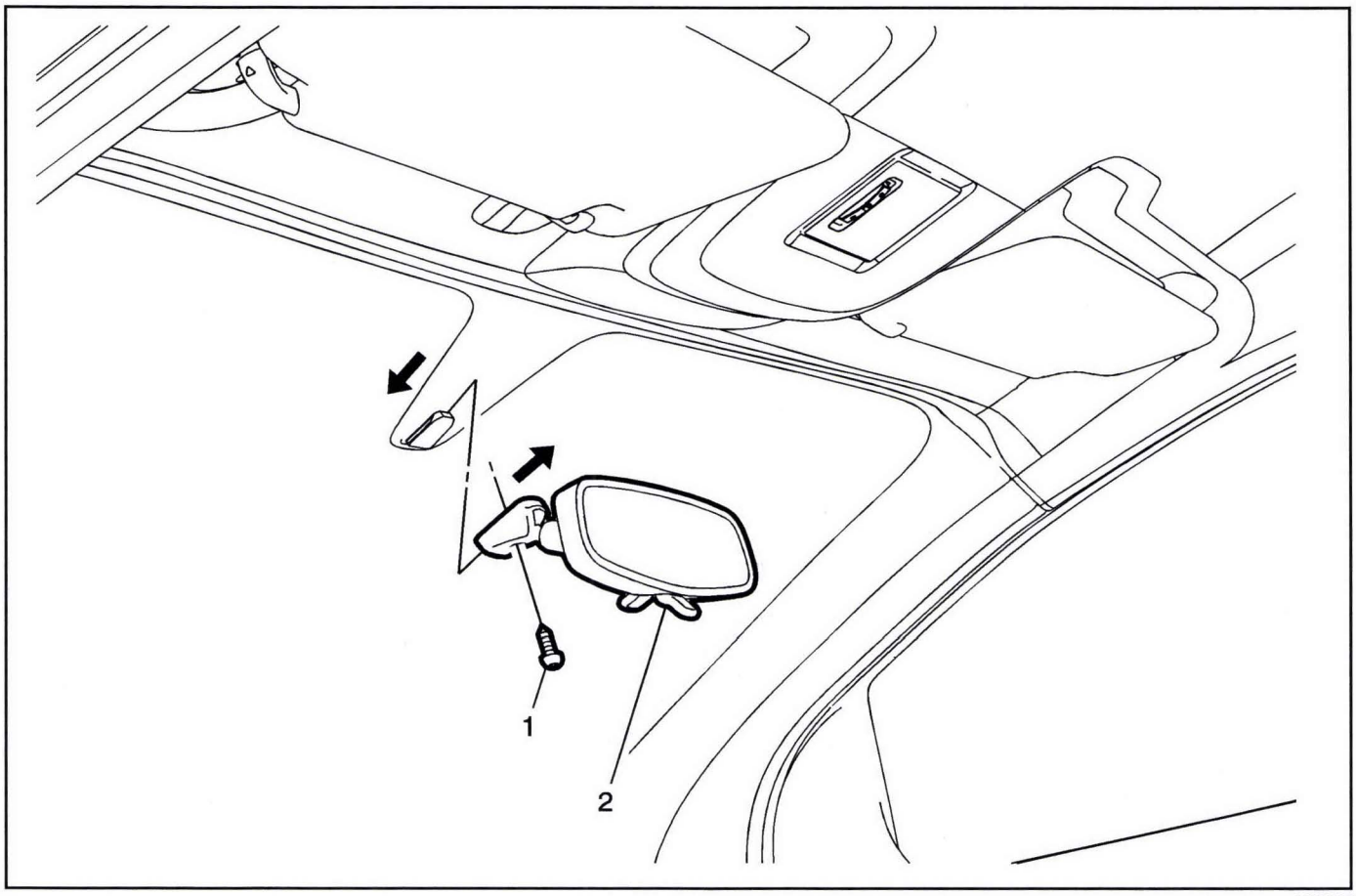
1. Place the mirror glass on the lower motor ring retainers.
2. Place one hand on the back of the mirror housing, using the flat palm of the other hand press inward locking the mirror glass to the motor ring.
3. Remove the masking tape from the mirror glass.
4. Inspect the outside mirror for proper operation.

Inside Rearview Mirror Replacement



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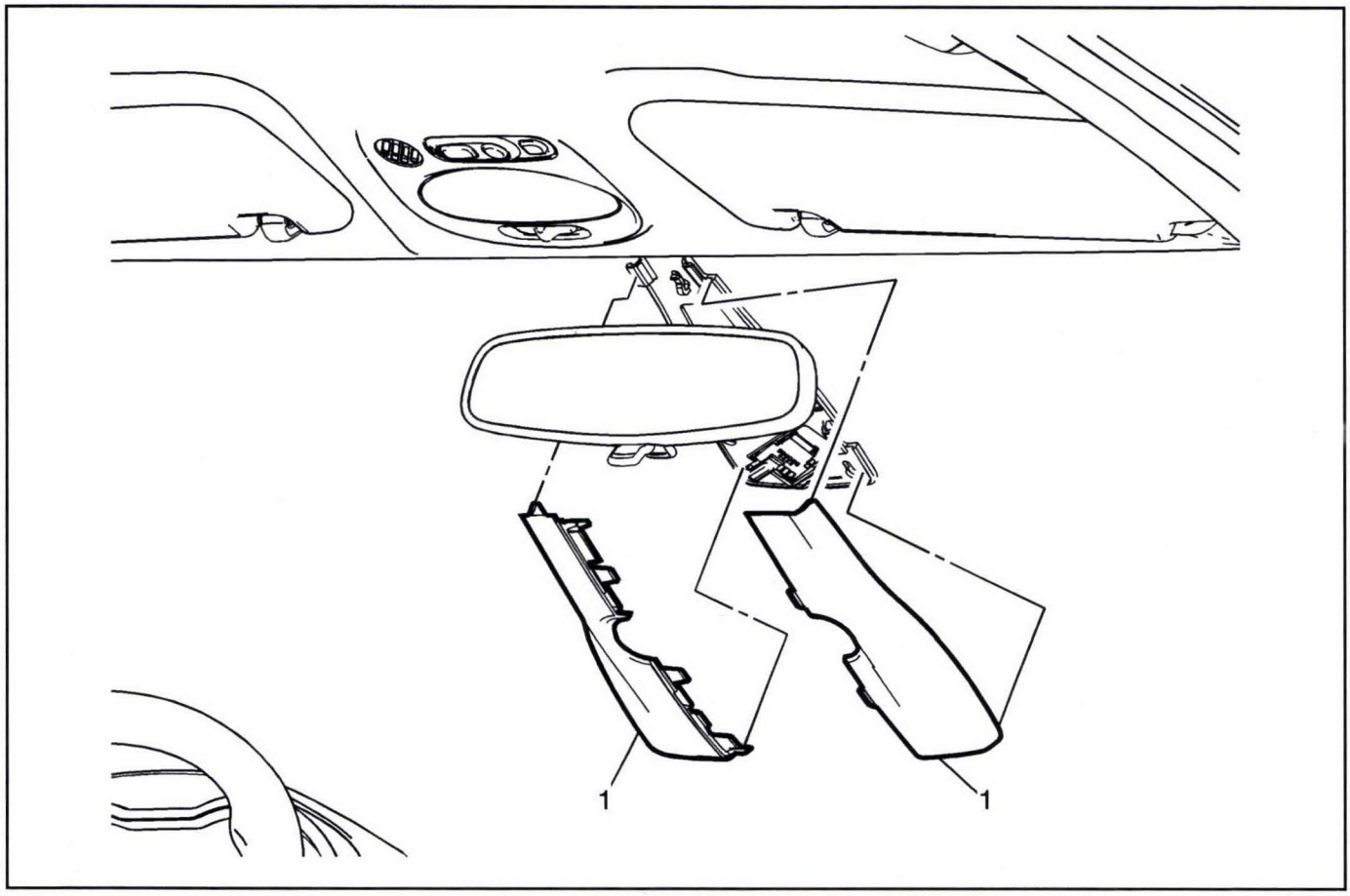
Inside Rearview Mirror Replacement

Callout	Component Name
Preliminary Procedure Remove the inside rearview mirror base cover. Refer to *Inside Rearview Mirror Wiring Harness Cover Replacement on page 4-216*.	
1	Inside Rearview Mirror Screw **Caution:** Refer to *Fastener Caution on page 0-8*. **Procedure** 1. Disconnect the electrical connector. 2. Adjust the mirror to the full upward position, loosen the screw at the base in order to remove the mirror from the button. 3. Slide the mirror in an upward motion in order to remove. **Tighten** 2 N•m (18 lb in)
2	Inside Rearview Mirror

Inside Rearview Mirror Wiring Harness Cover Replacement



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Inside Rearview Mirror Wiring Harness Cover Replacement

Callout	Component Name
1	Inside Rearview Mirror Wiring Harness Cover **Procedure** Grasp the cover on both sides and gentle pull apart and down.

Description and Operation

Outside Mirror Description and Operation

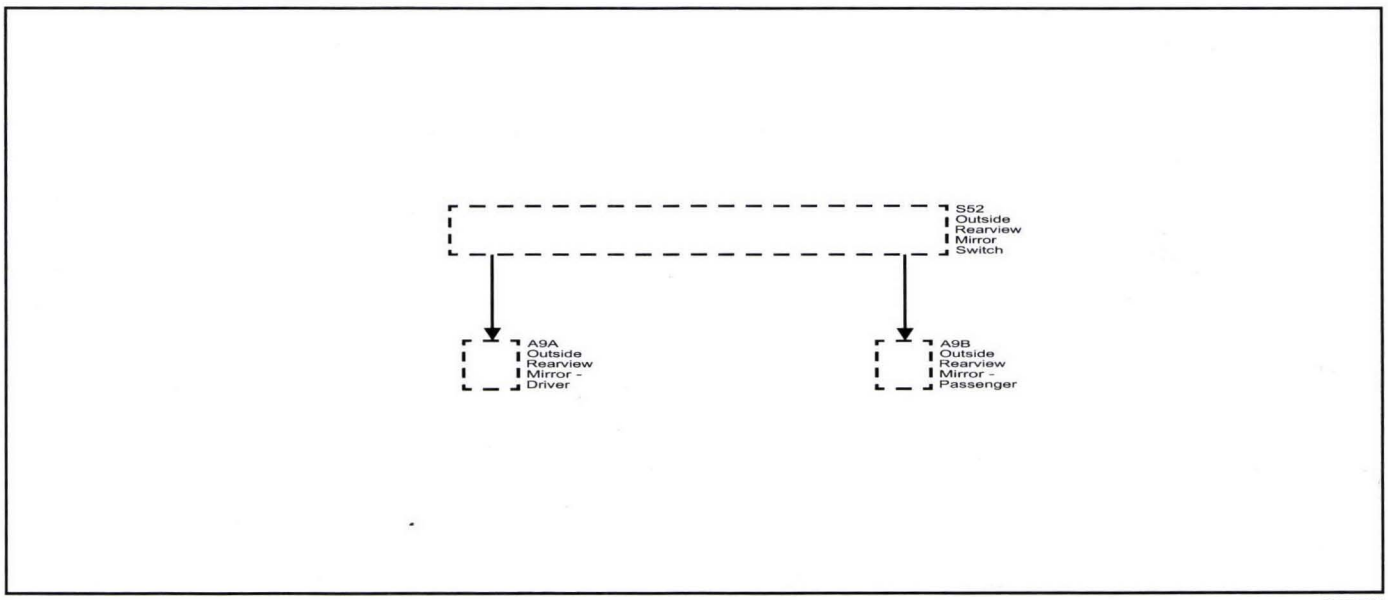
Power Mirror System Components

The power mirror system consists of the following components:

- Mirror direction switch — Controls the left, right, up and down movements of the mirrors
- Mirror select switch — Allows the operator to select the mirror to be moved
- Left outside mirror — Contains both the horizontal and vertical mirror motors
- Right outside mirror — Contains both the horizontal and vertical mirror motors
- 10A fuse — Located in the instrument panel (I/P) fuse block and supplies power for the power mirror system

Each of the outside power mirrors contains 2 motors. The up-down motor operates the vertical directions and the left-right motor operates the horizontal directions. Each of the power mirror motors are internally circuit breaker protected.

Power Mirros Without A45 Block Diagram



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Power Mirror System Controls

The outside mirror switch incorporates a mirror select switch and a 4 position mirror direction switch.

The mirror select switch allows the driver to select the mirror to be moved by pressing the switch to L position enabling the left outside mirror or pressing the switch to R position enabling the right outside mirror.

The mirror direction switch is a 4 position switch that allows the operator to move the selected mirror up, down, left or right.

Power Mirror System Operation

The outside mirror switch receives power through the battery positive voltage circuit from the 10A fuse in the instrument panel (I/P) fuse block. The outside mirror switch also receives a constant ground.

The 4 positions of the direction switch have multiple switch contacts. When not in use, the directional contacts are isolated from any circuit. Each of the contacts are connected to opposing sides of the appropriate mirror motors through the selector switch. The selector switch interrupts or completes these circuits depending on the position of the selector switch, L or R.

If the mirror select switch is placed in the L position and the up switch is pressed, battery voltage will be supplied to the driver outside mirror vertical motor through the driver mirror motor up control circuit and return to the mirror switch through the driver mirror motor left/down control circuit, then to ground and the mirror will move up. If the down switch is pressed, the driver mirror motor left/down control circuit supplies battery voltage and the driver mirror motor up control circuit completes the path to the mirror switch, then to ground and the mirror will move down.

The remainder of the mirror functions operate in the same manner as described above. Placing the mirror direction switch in opposing positions, left/right or up/down, will reverse the voltage polarity to the mirror motor, utilizing the same circuits and the mirror will move accordingly.

Heated Mirror System Operation

The rear window defogger system controls the operation of the driver and passenger rearview mirror heaters. When the rear window defogger switch is activated, the DEFOG relay in the IP fuse block is energized sending B+ through the defog mirror 15A fuse to the driver and passenger rearview mirror heaters. The mirror heaters are connected to separate ground circuits.

Vehicle Access

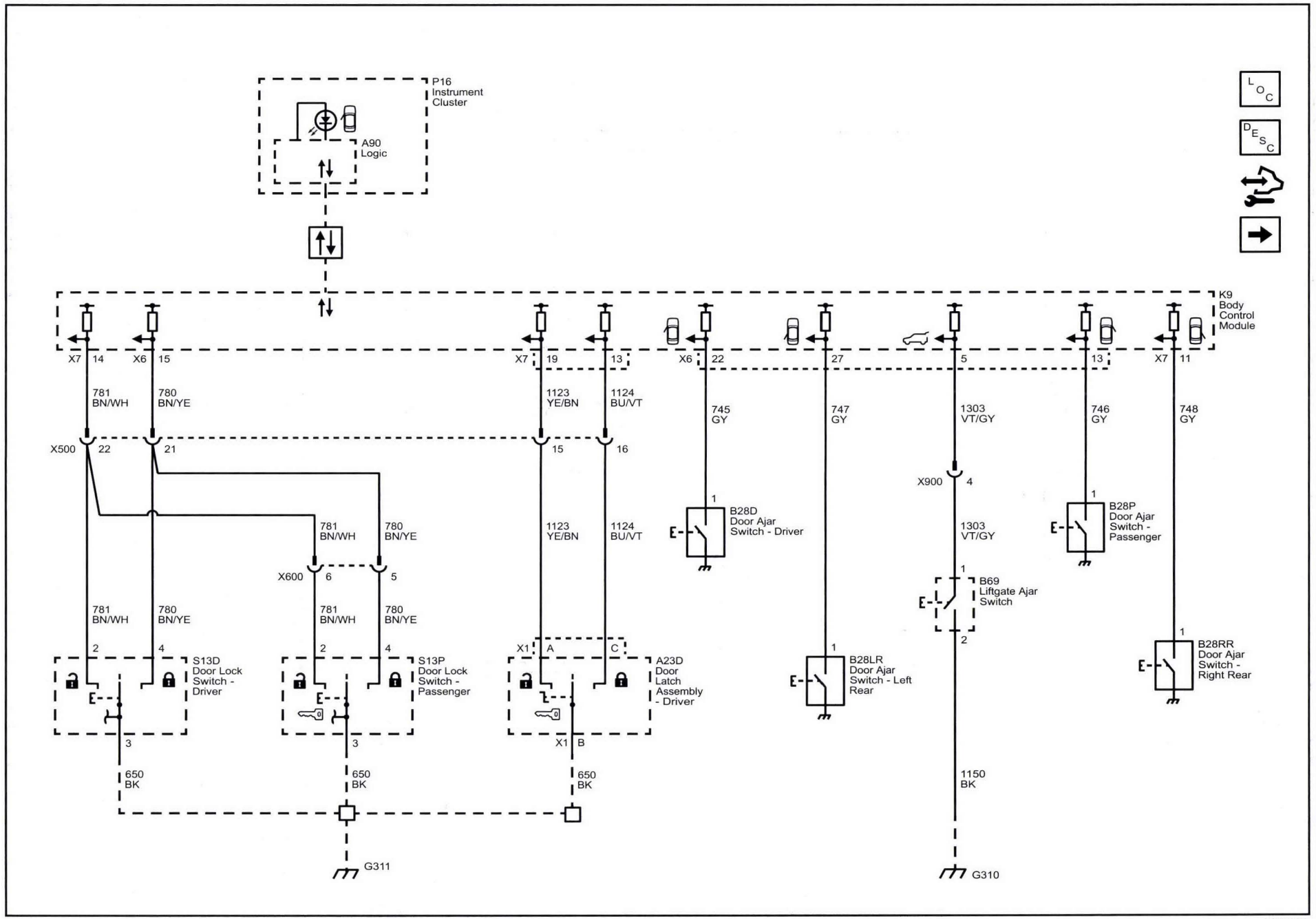
Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Front Side Door Lock Cylinder Bolts	4.5 N•m	40 lb in
Front Side Door Lock Screws	8.5 N•m	75 lb in
Front Side Door Outside Handle Bolts	4.5 N•m	40 lb in
Front Side Door Striker Screws	30 N•m	22 lb ft
Liftgate Latch Bolts	12 N•m	108 lb in
Liftgate Latch Striker Bolts	20 N•m	15 lb ft
Liftgate Lock Cylinder Bolts	5 N•m	44 lb in
Liftgate Outside Handle Nuts	5 N•m	44 lb in
Rear Side Door Lock Cylinder Bolts	4.5 N•m	40 lb in
Rear Side Door Lock Screws	8.5 N•m	75 lb in
Rear Side Door Outside Handle Bolts	9 N•m	44 lb in
Rear Side Door Striker Screws	30 N•m	22 lb ft

Schematic and Routing Diagrams

Door Lock/Indicator Schematics (Switches and Door Ajar Indicator)



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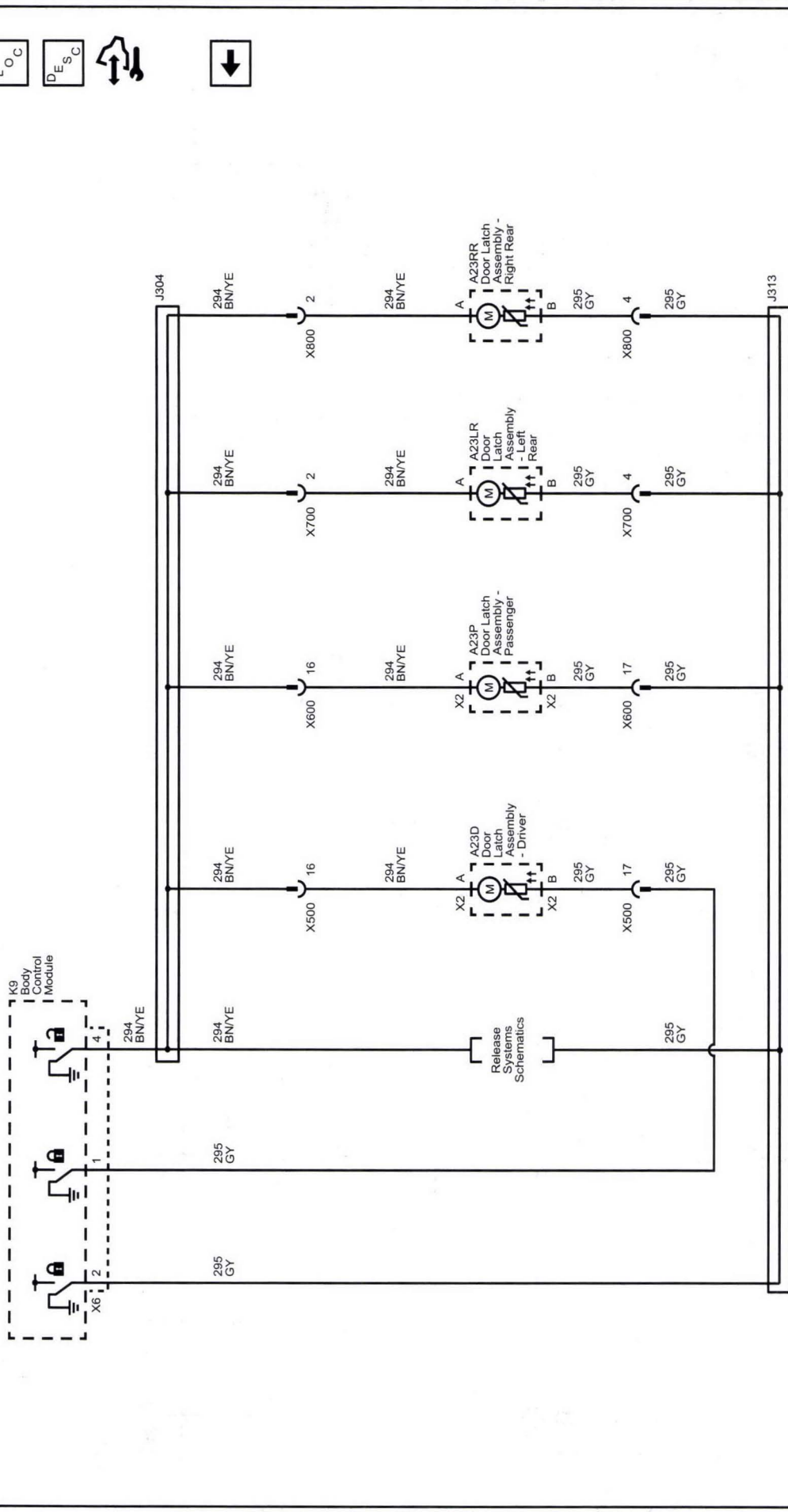
Door Lock/Indicator Schematics (Door Lock Actuators)



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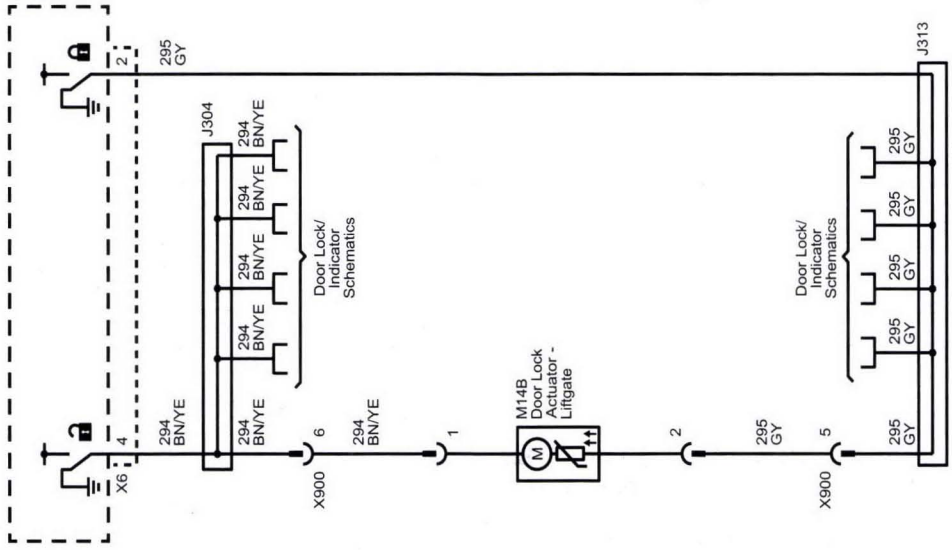
Release Systems Schematics (Liftgate Release)



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Diagnostic Information and Procedures

DTC B3125, B3130, or B3135 (With AU3)

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B3125: Driver Door Only Unlock Circuit

DTC B3130: All Doors Unlock Circuit

DTC B3135: All Doors Lock Circuit

For symptom byte information, refer to *Symptom Byte List on page 6-117*.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
BCM B+	B3125 02, B3130 02, B3135 02	B3125 02, B3130 02, B3135 02	—	—
Door Latch Control	B3125 02, B3130 02, B3135 02	B3125 04, B3130 04, B3135 04	B3125 01, B3130 01, B3135 01	—
Driver Door Lock Motor Lock Control	B3125 02, B3130 02, B3135 02	B3125 04, B3130 04, B3135 04	B3125 01, B3130 01, B3135 01	—
Door Lock Actuator Unlock Control	B3125 02, B3130 02, B3135 02	B3125 04, B3130 04, B3135 04	B3125 01, B3130 01, B3135 01	—

Circuit/System Description

The body control module (BCM) powers the reversible liftgate and door latch assemblies by providing battery positive voltage and ground to the appropriate lock and unlock control circuits of the liftgate and door latch assemblies. The lock and unlock control circuits of the liftgate, rear doors and passenger door latch assemblies are all connected together. When the door latch assemblies are not active, all actuator lock and unlock control circuits are supplied a floating voltage used by the BCM to perform diagnostic functions on the circuits. Transitioning of the lock actuators to the lock or unlocked position depends upon which control circuits receive voltage and which control circuits receive ground.

Conditions for Running the DTC

Vehicle in Service Mode

Conditions for Setting the DTC

B3125 01, B3130 01, B3135 01

The BCM detects a short to battery on a door latch control circuit

B3125 02, B3130 02 and B3135 02

- A short to ground or an open/high resistance in the BCM B+ circuit.
- The BCM detects a short to ground on a door latch control circuit.

B3125 04, B3130 04, B3135 04

The BCM detects an open/high resistance on a door latch control circuit

Action Taken When the DTC Sets

The BCM will disable the lock and unlock functions of the door latches.

Conditions for Clearing the DTC

- This DTC will be current for as long as the fault is present.
- When the fault is no longer present, the DTC will be a history DTC.
- A history DTC will clear after 50 ignition cycles.

Reference Information

Schematic Reference

- *Door Lock/Indicator Schematics on page 4-219*
- *Release Systems Schematics on page 4-221*
- *Body Control System Schematics on page 11-14*

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Power Door Locks Description and Operation on page 4-283

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify all vehicle doors and liftgate lock and unlock when commanding the All Doors Lock/Unlock with a scan tool.

⇒ **If only the driver door does not lock and unlock**

Refer to Circuit/System Testing – Driver Door Lock Malfunction.

⇒ **If one or more passenger doors or the liftgate does not lock and unlock**

Refer to Circuit/System Testing – Passenger Door Lock Malfunction.

⇒ **If the liftgate and all doors do not lock and unlock**

Refer to Circuit/System Testing – All Door Lock Inoperative.

⇓ **If all doors lock and unlock**

3. All OK.

Circuit/System Testing

Driver Door Lock Malfunction

1. Vehicle OFF, disconnect the X6 harness connector at the K9 Body Control Module, Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit terminal 1 and ground.

⇒ **If 1 V or greater**

2.1. Vehicle OFF, disconnect the harness connector at the A23D Door Latch Assembly – Driver, Vehicle in Service Mode.

2.2. Test for less than 1 V between the control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ **If less than 1 V**

3. Vehicle OFF, connect the X6 harness connector at the K9 Body Control Module. Disconnect the harness connector at the A23D Door Latch Assembly–Driver, Vehicle in Service Mode.

Note: Leaving the DMM connected between a control circuit and ground for greater than 20 s may cause the K9 Body Control Module to interpret the test as a system fault and will cause the voltage on the control circuit to drop to 0 V. If the voltage drops to 0 V, operate the door locks using the door lock switch to restore the voltage for testing.

4. Test for greater than 3 V between the control circuit terminals listed below and ground:
   - Control circuit terminal A
   - Control circuit terminal B

⇒ **If 3 V or less**

4.1. Vehicle OFF, disconnect the X6 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance on the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If greater than 3 V**

Note: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 00.00 V.

5. Install a DMM between the control circuit terminal A and control circuit terminal B Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 00.00 V.
6. Lock and unlock the vehicle doors using the S13D Door Lock Switch-Driver.

7. Verify the MAX voltage captured by the DMM is greater than 10 V.

⇒ **If 10 V or less**

Replace the K9 Body Control Module.

⇓ **If greater than 10 V**

8. Test or replace the A23D Door Latch Assembly–Driver.

Passenger Door Lock Malfunction

1. Vehicle OFF, disconnect the X6 harness connector at the K9 Body Control Module, Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit terminal 2 and ground.

⇒ **If 1 V or greater**

2.1. Vehicle OFF, disconnect the harness connector at the A23P Door Latch Assembly – Passenger, A23LR Door Latch Assembly – Left Rear, A23RR Door Latch Assembly – Right Rear and M14B Door Lock Actuator-Liftgate, Vehicle in Service Mode.

2.2. Test for less than 1 V between the control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ **If less than 1 V**

3. Vehicle OFF, connect the X6 harness connector at the K9 Body Control Module. Disconnect the harness connector at the appropriate M14B Door Lock Actuator-Liftgate, or the A23P Door Latch Assembly-Passenger or A23 Door Latch Assembly-Rear.

Note: Leaving the DMM connected between a control circuit and ground for greater than 20 s may cause the K9 Body Control Module to interpret the test as a system fault and will cause the voltage on the control circuit to drop to 0 V. If the voltage drops to 0 V, operate the door locks using the door lock switch to restore the voltage for testing.

4. Test for greater than 3 V between the control circuit terminal listed below and ground:
   - A23P Door Latch Assembly-Passenger — control circuit terminal A
   - A23P Door Latch Assembly-Passenger — control circuit terminal B
   - A23RR Door Latch Assembly-Right Rear — control circuit terminal A
   - A23RR Door Latch Assembly-Right Rear — control circuit terminal B
   - A23LR Door Latch Assembly-Left Rear — control circuit terminal A
   - A23LR Door Latch Assembly-Left Rear — control circuit terminal B
   - M14B Door Lock Actuator-Liftgate — control circuit terminal 1
   - M14B Door Lock Actuator-Liftgate — control circuit terminal 2

⇒ **If 3 V or less**

4.1. Vehicle OFF, disconnect the X6 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance on the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If greater than 3 V**

Note: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 00.00 V.

5. Install a DMM between the control circuits listed below. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 00.00 V.
   - A23P Door Latch Assembly-Passenger – control circuit terminal A and control circuit terminal B
   - A23RR Door Latch Assembly-Right Rear – control circuit terminal A and control circuit terminal B
   - A23LR Door Latch Assembly-Left Rear – control circuit terminal A and control circuit terminal B
   - M14B Door Lock Actuator-Liftgate — control circuit terminal 1 and control circuit terminal 2
6. Lock and unlock the vehicle doors using the door lock switch.
7. Verify the MAX voltage captured by the DMM is greater than 10 V.

⇒ **If 10 V or less**

Replace the K9 Body Control Module.

⇓ **If greater than 10 V**

8. Test or replace the A23 Door Latch Assembly or M14B Door Lock Actuator-Liftgate.

All Door Locks Inoperative

1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, Vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

2.3. Vehicle OFF.

2.4. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

2.5. Disconnect the harness connector at each of the A23 Door Latch Assemblies and the M14B Door Lock Actuator-Liftgate.

2.6. Test for infinite resistance between each control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the appropriate A23 Door Latch Assembly or M14B Door Lock Actuator-Liftgate.

⇓ **If the test lamp illuminates**

3. Vehicle OFF, connect the X2 harness connector at the K9 Body Control Module. Disconnect the X6 harness connector at the K9 Body Control Module, Vehicle in Service Mode.
4. Test for less than 1 V between the control circuit terminals listed below and ground:
   - Control circuit terminal 1 X6
   - Control circuit terminal 2 X6
   - Control circuit terminal 4 X6

⇒ **If 1 V or greater**

4.1. Vehicle OFF, disconnect the harness connector at the A23D Door Latch Assembly – Driver, A23P Door Latch Assembly – Passenger, A23LR Door Latch Assembly – Left Rear, A23RR Door Latch Assembly – Right Rear and M14B Door Lock Actuator-Liftgate, Vehicle in Service Mode.

4.2. Test for less than 1 V between the control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ **If less than 1 V**

5. Test for infinite resistance between the control circuit terminals listed below and ground:
   - Control circuit terminal 1 X6
   - Control circuit terminal 2 X6
   - Control circuit terminal 4 X6

⇒ **If less than infinite resistance**

5.1. Vehicle OFF, disconnect the harness connector at the A23D Door Latch Assembly – Driver, A23P Door Latch Assembly – Passenger, A23LR Door Latch Assembly – Left Rear, A23RR Door Latch Assembly – Right Rear and M14B Door Lock Actuator-Liftgate.

5.2. Test for less than infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ **If infinite resistance**

6. Test for less than 10 Ω between the control circuit terminal 1 and the control circuit terminal 4.

⇒ **If 10 Ω or greater**

6.1. Vehicle OFF, disconnect the harness connector at the A23D Door Latch Assembly – Driver.

6.2. Test for less than 2 Ω between the K9 Body Control Module control circuit terminal 4 and the A23D Door Latch Assembly – Driver control circuit terminal A.

⇒ If 2 Ω or greater, repair the open/high resistance on the circuit.

⇓ **If less than 10 Ω**

7. Test or replace the K9 Body Control Module.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the appropriate A23 Door Latch Assembly.
2. Install a 25 A fused jumper wire between one of the control terminals and 12 V. Momentarily install a jumper wire between the other control terminal and ground. Reverse the jumper wires at least two times, the A23 Door Latch Assembly should perform the LOCK and UNLOCK function.

⇒ **If the actuator does not perform the LOCK and UNLOCK function**

Replace the A23 Door Latch Assembly.

⇓ **If the actuator performs the LOCK and UNLOCK function**

3. All OK

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Liftgate Latch Replacement on page 4-265*
- *Front Side Door Lock Replacement on page 4-268*
- *Rear Side Door Lock Replacement on page 4-269*
- *Control Module References on page 6-3* for BCM replacement, programming and setup

DTC B3125, B3130, or B3135 (Without AU3)

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B3125: Driver Door Only Unlock Circuit

DTC B3130: All Doors Unlock Circuit

DTC B3135: All Doors Lock Circuit

For symptom byte information refer to: *Symptom Byte List on page 6-117*

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
BCM B+	B3125 02, B3130 02, B3135 02	B3125 02, B3130 02, B3135 02	—	—
Lock Control	B3125 02, B3130 02, B3135 02	B3125 04, B3130 04, B3135 04	B3125 01, B3130 01, B3135 01	—
Unlock Control	B3125 02, B3130 02, B3135 02	B3125 04, B3130 04, B3135 04	B3125 01, B3130 01, B3135 01	—

Circuit/System Description

When the vehicle does not have power door locks, it will be provided with a liftgate unlatch switch to lock or unlock the liftgate. The body control module (BCM) monitors the voltage level of the liftgate lock and liftgate unlock signal circuits. When the liftgate unlatch switch is in the open position, the voltage level in the signal circuit will be near 0 V. When the liftgate unlatch switch is pressed to the lock or unlock position, a signal will be sent to the BCM requesting a lock or unlock. command. When the liftgate latch assembly is not active, both lock and unlock control circuits are supplied a floating voltage by the BCM. Transitioning of the liftgate latch assembly to the lock or unlocked position depends upon which control circuits receive voltage and which control circuits receive ground

Conditions for Running the DTC

Vehicle in Service Mode

Conditions for Setting the DTC

B3125 01, B3130 01, B3135 01

The BCM detects a short to battery on the liftgate latch control circuit

B3125 02, B3130 02 and B3135 02

- A short to ground or an open/high resistance in the BCM B+ circuit.
- The BCM detects a short to ground on the liftgate latch control circuit.

B3125 04, B3130 04, B3135 04

The BCM detects an open/high resistance on the liftgate latch control circuit

Action Taken When the DTC Sets

The BCM will disable the liftgate lock and unlock commands.

Conditions for Clearing the DTC

- This DTC will be current for as long as the fault is present.
- When the fault is no longer present, the DTC will be a history DTC.
- A history DTC will clear after 50 ignition cycles.

Reference Information

Schematic Reference

- *Release Systems Schematics on page 4-221*
- *Body Control System Schematics on page 11-14*

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Rear Hatch/Gate Description and Operation on page 4-285

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*

- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when cycling the S46B Liftgate Unlatch Switch between LOCK and UNLOCK.

⇒ **If the parameter does not change**

Refer to *Trunk/Liftgate Lock Malfunction on page 4-249*.

⇓ **If the parameter changes**

3. Verify the A23C Liftgate Latch Assembly will LOCK and UNLOCK when commanding the All Doors Lock/Unlock with a scan tool.

⇒ **If the A23C Liftgate Latch Assembly LOCK or UNLOCK functions do not work**

Refer to Circuit/System Testing.

⇓ **If the A23C Liftgate Latch Assembly LOCK and UNLOCK function works**

4. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, Vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

2.1. Vehicle OFF.

2.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

2.3. Disconnect the harness connector at the A23C Liftgate Latch Assembly.

2.4. Test for infinite resistance between each control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the A23C Liftgate Latch Assembly.

⇓ **If the test lamp illuminates**

3. Vehicle OFF, connect the X2 harness connector at the K9 Body Control Module and disconnect the harness connector at the A23C Liftgate Latch Assembly. Vehicle in Service Mode.

Note: Leaving the DMM connected between a control circuit and ground for greater than 20 seconds will cause the K9 body control module to interpret the test as a system fault and will cause the voltage on the control circuit to drop to 0 V. If the voltage drops to 0 V, operate the liftgate latch by using the S46B Liftgate Unlatch Switch to restore the voltage for testing.

4. Test for greater than 7 V between the control circuit terminal 1 and ground.

⇒ **If 7 V or less**

4.1. Vehicle OFF, disconnect the X6 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance on the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If greater than 7 V**

Note: Leaving the DMM connected between a control circuit and ground for greater than 20 seconds will cause the K9 body control module to interpret the test as a system fault and will cause the voltage on the control circuit to drop to 0 V. If the voltage drops to 0 V, operate the liftgate latch by using the S46B Liftgate Unlatch Switch to restore the voltage for testing.

5. Test for greater than 7 V between the control circuit terminal 2 and ground.

⇒ **If 7 V or less**

5.1. Vehicle OFF, disconnect the X6 harness connector at the K9 Body Control Module.

5.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

5.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance on the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If greater than 7 V**

6. Test or replace the A23C Liftgate Latch Assembly.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the A23C Liftgate Latch Assembly.
2. Install a 25 A fused jumper wire between one of the control terminals and 12 V. Momentarily install a jumper wire between the other control terminal and ground. Reverse the jumper wires at least two times, the A23C Liftgate Latch Assembly should perform the LOCK and UNLOCK function.

⇒ **If the actuator does not perform the LOCK and UNLOCK function**

Replace the A23C Liftgate Latch Assembly.

⇓ **If the actuator performs the LOCK and UNLOCK function**

3. All OK

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Liftgate Latch Replacement on page 4-265*
- *Control Module References on page 6-3* for BCM replacement, programming and setup

DTC B3140 or B3150 (With AU3)

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B3140 00: Driver Door Unlock Switch Circuit

DTC B3150 00: Left Front Door Lock Switch Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Driver Door Lock Switch Lock Signal	B3150 00	2	2	—
Driver Door Lock Switch Unlock Signal	B3140 00	3	3	—
Driver Door Lock Switch Ground	—	1	—	—
Passenger Door Lock Switch Lock Signal	B3150 00	4	4	—
Passenger Door Lock Switch Unlock Signal	B3140 00	5	5	—
Passenger Door Lock Switch Ground	—	6	—	—

1. Driver Door Lock Switch Inoperative
2. Driver Door Lock Switch Lock Function Inoperative
3. Driver Door Lock Switch Unlock Function Inoperative
4. Passenger Door Lock Switch Lock Function Inoperative
5. Passenger Door Lock Switch Unlock Function Inoperative
6. Passenger Door Lock Switch Inoperative

Circuit/System Description

The Body Control Module supplies a 12 V signal to each of the door lock and door unlock signal circuits. When the door lock switches are in the open position, the voltage level in the signal circuit will be near 12 V. When any door lock switch is pressed to the lock or unlock position, the voltage level in the appropriate signal circuit will drop to 0 V and the Body Control Module will detect the voltage drop and command the door latches to perform the requested lock or unlock command.

Conditions for Running the DTC

The system voltage is 9–16 V.

Conditions for Setting the DTC

B3140 00

The Body Control Module detects short to ground in the lock signal circuit for greater than 60 seconds.

B3150 00

The Body Control Module detects a short to ground in the lock signal circuit for greater than 60 seconds.

Action Taken When the DTC Sets

B3140 00

The Body Control Module will ignore the unlock signal and the doors will not unlock when using the passenger or driver door unlock switch.

B3150 00

The Body Control Module will ignore the lock signal and the doors will not lock when using the passenger or driver door lock switch.

Conditions for Clearing the DTC

- The DTC will be current for as long as the fault is present.
- When the fault is no longer present, the DTC will be a history DTC.
- A history DTC will clear after 50 ignition cycles.

Reference Information

Schematic Reference

Door Lock/Indicator Schematics on page 4-219

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Power Door Locks Description and Operation on page 4-283

Electrical Information Reference

- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Circuit Testing on page 11-871*
- *Wiring Repairs on page 11-883*
- *Connector Repairs on page 11-895*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when pushing the appropriate switch on the S13D Door Lock Switch-Driver.

⇒ **If the parameter is always Inactive**

Refer to Circuit/System Testing — Door Lock Switch Inoperative.

⇒ **If the parameter changes between Inactive and Lock only**

Refer to Circuit/System Testing — Door Lock Switch Malfunction.

⇒ **If the parameter changes between Inactive and Unlock only**

Refer to Circuit/System Testing — Door Lock Switch Malfunction.

⇒ **If the parameter is always Lock**

Refer to Circuit/System Testing — Lock/Unlock Signal Circuit Test.

⇒ **If the parameter is always Unlock**

Refer to Circuit/System Testing — Lock/Unlock Signal Circuit Test.

⇓ **If the parameter changes**

3. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when pushing the appropriate switch on the S13P Door Lock Switch-Passenger.

⇒ **If the parameter is always Inactive**

Refer to Circuit/System Testing — Door Lock Switch Inoperative.

⇒ **If the parameter changes between Inactive and Lock only**

Refer to Circuit/System Testing — Door Lock Switch Malfunction.

⇒ **If the parameter changes between Inactive and Unlock only**

Refer to Circuit/System Testing — Door Lock Switch Malfunction.

⇒ **If the parameter is always Lock**

Refer to Circuit/System Testing — Lock/Unlock Signal Circuit Test.

⇒ **If the parameter is always Unlock**

Refer to Circuit/System Testing — Lock/Unlock Signal Circuit Test.

⇓ **If the parameter changes**

4. All OK.

Circuit/System Testing

Door Lock Switch Inoperative

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate S13 Door Lock Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Test or replace the S13 Door Lock Switch.

Door Lock Switch Malfunction

1. Vehicle OFF, disconnect the harness connector at the appropriate S13 Door Lock Switch. Vehicle in Service Mode
2. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 3.

3. Verify the scan tool Door Lock Switch parameter is Unlock.

⇒ **If not Unlock**

3.1. Vehicle OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.

3.2. Test for less than 1 V between the signal circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

3.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Unlock**

4. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the ground circuit terminal 3.
5. Verify the scan tool Door Lock Switch parameter is Lock.

⇒ **If not Lock**

5.1. Vehicle OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.

5.2. Test for less than 1 V between the signal circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

5.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Lock**

6. Test or replace the S13 Door Lock Switch.

Lock/Unlock Signal Circuit Test

1. Vehicle OFF, disconnect the harness connector at the S13D Door Lock Switch-Driver and the S13P Door Lock Switch-Passenger. Vehicle in Service Mode.
2. Verify the scan tool Door Lock Switch parameter is Inactive.

⇒ **If not Inactive**

2.1. Vehicle OFF, disconnect the X6 and X7 harness connectors at the K9 Body Control Module.

2.2. Test for infinite resistance between the signal circuit terminal listed below and ground.

- Signal circuit terminal 2
- Signal circuit terminal 4

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance, replace the K9 Body Control Module

⇓ **If Inactive**

3. Connect the harness connector at the S13P Door Lock Switch-Passenger.
4. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when pushing the appropriate switch on the S13P Door Lock Switch-Passenger.

⇒ **If Lock**

Test or replace the S13P Door Lock Switch-Passenger.

⇒ **If Unlock**

Test or replace the S13P Door Lock Switch-Passenger.

⇓ **If the parameter changes**

5. Connect the harness connector at the S13D Door Lock Switch-Driver.
6. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when pushing the appropriate switch on the S13D Door Lock Switch-Driver.

⇒ **If Lock**

Test or replace the S13D Door Lock Switch-Driver.

⇒ **If Unlock**

Test or replace the S13D Door Lock Switch-Driver.

⇓ **If the parameter changes**

7. All OK.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the appropriate S13 Door Lock Switch.
2. Test for infinite resistance between the signal terminal 2 and the ground terminal 3 with the switch in the open position.

⇒ **If less than infinite resistance**

Replace the S13 Door Lock Switch.

⇓ **If infinite resistance**

3. Test for infinite resistance between the signal terminal 4 and the ground terminal 3 with the switch in the open position.

⇒ **If less than infinite resistance**

Replace the S13 Door Lock Switch.

⇓ **If infinite resistance**

4. Test for less than 2 Ω between the signal terminal 2 and the ground terminal 3 with the switch in the Unlock position.

⇒ **If 2 Ω or greater**

Replace the S13 Door Lock Switch.

⇓ **If less than 2 Ω**

5. Test for less than 2 Ω between the signal terminal 4 and the ground terminal 3 with the switch in the Lock position.

⇒ **If 2 Ω or greater**

Replace the S13 Door Lock Switch.

⇓ **If less than 2 Ω**

6. All OK

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Door Lock Switch Replacement on page 4-281*
- *Control Module References on page 6-3* for Body Control Module replacement, programming and setup

DTC B3140 or B3150 (Without AU3)

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B3140 00: Driver Door Unlock Switch Circuit
DTC B3150 00: Left Front Door Lock Switch Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Lock Signal	B3150 00	1	1	—
Unlock Signal	B3140 00	2	2	—
Ground	—	3	—	—

1. Liftgate Lock Switch Lock Function Inoperative
2. Liftgate Lock Switch Unlock Function Inoperative
3. Liftgate Lock Switch Lock and Unlock Functions Inoperative

Circuit/System Description

When the vehicle is equipped with out power door locks, it will be provided with a liftgate unlatch switch to lock or unlock the liftgate. The body control module monitors the voltage level of the liftgate lock and liftgate unlock signal circuits. When the liftgate unlatch switch is in the open position, the voltage level in the signal circuit will be near 0 V. When the liftgate unlatch switch is pressed to the lock or unlock position, a signal will be sent to the body control module requesting a lock or unlock command.

Conditions for Running the DTC

The system voltage is 9–16 V.

Conditions for Setting the DTC

B3140 00

The body control module detects short to ground in the unlock signal circuit for greater than 60 seconds.

B3150 00

The body control module detects a short to ground in the lock signal circuit for greater than 60 seconds.

Action Taken When the DTC Sets

B3140 00

The body control module will ignore the unlock signal and the liftgate will not unlock when using the liftgate unlatch switch.

B3150 00

The body control modulee will ignore the lock signal and the liftgate will not lock when using the liftgate unlatch switch.

Conditions for Clearing the DTC

- The DTC will be current for as long as the fault is present.
- When the fault is no longer present, the DTC will be a history DTC.
- A history DTC will clear after 50 ignition cycles.

Reference Information

Schematic Reference

Release Systems Schematics on page 4-221

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Rear Hatch/Gate Description and Operation on page 4-285

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when pushing the appropriate switch on the S46B Liftgate Unlatch Switch.

⇒ **If the parameter does not change**

Refer to Circuit/System Testing.

⇓ **If the parameter changes**

3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S46B Liftgate Unlatch Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Door Lock Switch parameter is Inactive.

⇒ **If not Inactive**

4.1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit terminal 2 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

4.3. Test for infinite resistance between the signal circuit terminal 3 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ground circuit terminal 4.
6. Verify the scan tool Door Lock Switch parameter is Unlock.

⇒ **If not Unlock**

6.1. Vehicle OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit terminal 3 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Unlock**

7. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 4.
8. Verify the scan tool Door Lock Switch parameter is Lock.

⇒ **If not Lock**

8.1. Vehicle OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.

8.2. Test for less than 1 V between the signal circuit terminal 2 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

8.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Lock**

9. Test or replace the S46B Liftgate Unlatch Switch.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the S46B Liftgate Unlatch Switch.
2. Test for infinite resistance between the signal terminal 2 and the ground terminal 4 with the switch in the open position.

⇒ **If less than infinite resistance**

Replace the S46B Liftgate Unlatch Switch.

⇓ **If infinite resistance**

3. Test for infinite resistance between the signal terminal 3 and the ground terminal 4 with the switch in the open position.

⇒ **If less than infinite resistance**

Replace the S46B Liftgate Unlatch Switch.

⇓ **If infinite resistance**

4. Test for less than 2 Ω between the signal terminal 2 and the ground terminal 4 with the switch in the Lock position.

⇒ **If 2 Ω or greater**

Replace the S46B Liftgate Unlatch Switch.

⇓ **If less than 2 Ω**

5. Test for less than 2 Ω between the signal terminal 3 and the ground terminal 4 with the switch in the Unlock position.

⇒ **If 2 Ω or greater**

Replace the S46B Liftgate Unlatch Switch.

⇓ **If less than 2 Ω**

6. All OK

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Instrument Panel Trim Plate Applique Replacement - Left Side on page 2-24*
- *Control Module References on page 6-3* for body control module replacement, programming and setup

DTC P0CCC, P0CCE, or P0CCF

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC P0CCC 00: Charge Port Door Position Sensor Circuit
DTC P0CCE 00: Charge Port Door Position Sensor Circuit Low Voltage
DTC P0CCF 00: Charge Port Door Position Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open	High Resistance	Short to Voltage	Signal Performance
Signal	P0CCE 00	P0CCE 00	P0CCC 00	P0CCF 00	—
Ground	—	P0CCE 00	P0CCC 00	—	—

Circuit/System Description

The hybrid/EV powertrain control module 2 provides a 5V signal through a pull-up resistor to the charge port door position sensor circuit. The other end of the charge port door position sensor circuit is connected to the charge port door position switch. The hybrid/EV powertrain control module 2 monitors the voltage on the charge port door position sensor circuit. In normal operation, the hybrid/EV powertrain control module 2 sends a serial data message to the driver information center in the instrument panel cluster to display the Charge Door Open message.

Conditions for Running the DTC

Hybrid/EV powertrain control module 2 must be awake.

Conditions for Setting the DTC

P0CCC 00

The hybrid/EV powertrain control module 2 detects the charge port door position sensor signal circuit voltage is mid range between expected high and low voltage values

P0CCE 00

The hybrid/EV powertrain control module 2 detects a short to ground in the charge port position sensor circuit.

P0CCF 00

The hybrid/EV powertrain control module 2 detects a short to voltage or an open/high resistance in the charge port position sensor circuit.

Action Taken When the DTC Sets

The Charge Door Open message will not illuminate when the charge port door is open or ajar.

Conditions for Clearing the DTC

DTC P0CCC 00, P0CCE 00 and P0CCF 00 are type C DTCs

Reference Information

Schematic Reference

Plug-In Charging Schematics on page 9-553

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Charge Port Door Description and Operation on page 4-282

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Charge Port Door parameter changes between Open and Closed when opening and closing the charge port door.

⇒ **If the parameter does not change**

Refer to Circuit/System Testing.

⇓ **If the parameter changes**

3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the B197 Charge Port Door Position Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal C and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode, test for 4.8–5.2 V between the 5 V reference circuit terminal A and ground.

⇒ **If less than 4.8 V**

3.1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

3.2. Test for infinite resistance between the 5 V reference circuit and ground

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

3.3. Test for less than 2 Ω in the 5 V reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.

⇒ **If greater than 5.2 V**

3.1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2, Vehicle in Service Mode.

3.2. Test for less than 1 V between the 5 V reference circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.

⇓ **If between 4.8–5.2 V**

4. Test or replace the B197 Charge Port Door Position Switch.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the B197 Charge Port Door Position Switch.
2. Test for 180 Ω—190 Ω between the signal terminal A and the ground terminal C with the switch in the open position.

⇒ **If 191 Ω or greater**

Replace the B197 Charge Port Door Position Switch.

⇒ **If 179 Ω or less**

Replace the B197 Charge Port Door Position Switch.

⇓ **If 180 Ω—190 Ω**

3. Test for 2040 Ω—2065 Ω between the signal terminal A and the ground terminal C with the switch in the closed position.

⇒ **If 2066 Ω or greater**

Replace the B197 Charge Port Door Position Switch.

⇒ **If 2039 Ω or less**

Replace the B197 Charge Port Door Position Switch.

⇓ **If 2040 Ω—2065 Ω**

4. All OK

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Charge Port Housing Replacement on page 9-648*
- *Control Module References on page 6-3* for the hybrid/EV powertrain control module 2 replacement, programming and setu

Symptoms - Vehicle Access

Important Preliminary Checks Before Starting

1. Perform the *Diagnostic System Check - Vehicle on page 6-91* before using the Symptom Tables in order to verify that all of the following are true:
   - There are no DTCs set.
   - The control modules can communicate via the serial data link.
2. Review the following description and operations below in order to familiarize yourself with the system functions:

- *Power Door Locks Description and Operation on page 4-283*
- *Rear Hatch/Gate Description and Operation on page 4-285*
- *Door Ajar Indicator Description and Operation on page 4-282*
- *Charge Port Door Description and Operation on page 4-282*

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the system. Refer to *Checking Aftermarket Accessories on page 11-871*.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to *Testing for Intermittent Conditions and Poor Connections on page 11-877*.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- *Power Door Locks Malfunction on page 4-244*
- *Door Ajar Indicator Malfunction on page 4-240*
- *Trunk/Liftgate Lock Malfunction on page 4-249*
- *Power Door Lock Key Cylinder Switches Malfunction on page 4-242*
- *Charger Door Ajar Indicator Malfunction on page 4-238*

Charger Door Ajar Indicator Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC P0CCC 00: Charge Port Door Position Sensor Circuit
DTC P0CCE 00: Charge Port Door Position Sensor Circuit Low Voltage
DTC P0CCF 00: Charge Port Door Position Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open	High Resist-ance	Short to Voltage	Signal Perform-ance
Signal	P0CCE 00	P0CCE 00	P0CCC 00	P0CCF 00	—
Ground	—	P0CCE 00	P0CCC 00	—	—

Circuit/System Description

The hybrid/EV powertrain control module 2 provides a 5V signal through a pull-up resistor to the charge port door position sensor circuit. The other end of the charge port door position sensor circuit is connected to the charge port door position switch. The hybrid/EV powertrain control module 2 monitors the voltage on the charge port door position sensor circuit. In normal operation, the hybrid/EV powertrain control module 2 sends a serial data message to the driver information center in the instrument panel cluster to display the Charge Door Open message.

Conditions for Running the DTC

Hybrid/EV powertrain control module 2 must be awake.

Conditions for Setting the DTC

P0CCC 00

The hybrid/EV powertrain control module 2 detects the charge port door position sensor signal circuit voltage is mid range between expected high and low voltage values

P0CCE 00

The hybrid/EV powertrain control module 2 detects a short to ground in the charge port position sensor circuit.

P0CCF 00

The hybrid/EV powertrain control module 2 detects a short to voltage or an open/high resistance in the charge port position sensor circuit.

Action Taken When the DTC Sets

The Charge Door Open message will not illuminate when the charge port door is open or ajar.

Conditions for Clearing the DTC

DTC P0CCC 00, P0CCE 00 and P0CCF 00 are type C DTCs

Reference Information

Schematic Reference

Plug-In Charging Schematics on page 9-553

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Charge Port Door Description and Operation on page 4-282

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Charge Port Door parameter changes between Open and Closed when opening and closing the charge port door.

⇒ **If the parameter does not change**

Refer to Circuit/System Testing.

⇓ **If the parameter changes**

3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the B197 Charge Port Door Position Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal C and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode, test for 4.8–5.2 V between the 5 V reference circuit terminal A and ground.

⇒ **If less than 4.8 V**

3.1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

3.2. Test for infinite resistance between the 5 V reference circuit and ground

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

3.3. Test for less than 2 Ω in the 5 V reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.

⇒ **If greater than 5.2 V**

3.1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2, Vehicle in Service Mode.

3.2. Test for less than 1 V between the 5 V reference circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.

⇓ **If between 4.8–5.2 V**

4. Test or replace the B197 Charge Port Door Position Switch.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the B197 Charge Port Door Position Switch.
2. Test for 180 Ω—190 Ω between the signal terminal A and the ground terminal C with the switch in the open position.

⇒ **If 191 Ω or greater**

Replace the B197 Charge Port Door Position Switch.

⇒ **If 179 Ω or less**

Replace the B197 Charge Port Door Position Switch.

⇓ **If 180 Ω—190 Ω**

3. Test for 2040 Ω—2065 Ω between the signal terminal A and the ground terminal C with the switch in the closed position.

⇒ **If 2066 Ω or greater**

Replace the B197 Charge Port Door Position Switch.

⇒ **If 2039 Ω or less**

Replace the B197 Charge Port Door Position Switch.

⇓ **If 2040 Ω—2065 Ω**

4. All OK

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Charge Port Housing Replacement on page 9-648*
- *Control Module References on page 6-3* for the hybrid/EV powertrain control module 2 replacement, programming and setu

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Door Ajar Indicator Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Driver Door Ajar Switch Signal	1	2	1	—
Left Rear Door Ajar Switch Signal	1	2	1	—
Liftgate Latch Ajar Switch Signal	1	2	1	—
Liftgate Latch Ground	—	2	—	—
Passenger Door Ajar Switch Signal	1	2	1	—
Right Rear Door Ajar Switch Signal	1	2	1	—
1. Ajar Indicator Always Illuminated 2. Ajar Indicator Inoperative When Door or Liftgate Is Open				

Circuit/System Description

The Body Control Module provides a 12 V signal to each of the door ajar switch signal circuits and to the liftgate ajar switch signal circuit. When a door or liftgate is opened, the normally open contacts of the ajar switch closes. With the ajar switch closed, ground is provided to the ajar switch signal circuit. The Body Control Module interprets this and communicates via serial data with the instrument panel cluster which will display the door ajar icon.

Reference Information

Schematic Reference

Door Lock/Indicator Schematics on page 4-219

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Door Ajar Indicator Description and Operation on page 4-282

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Driver Door Ajar Switch parameter changes between Inactive and Active when opening and closing the driver door.

⇒ **If the parameter does not change**

Refer to Circuit/System Testing — Door Ajar Switch.

⇓ **If the parameter changes**

3. Verify the scan tool Passenger Door Ajar Switch parameter changes between Inactive and Active when opening and closing the passenger door.

⇒ **If the parameter does not change**

Refer to Circuit/System Testing — Door Ajar Switch.

⇓ **If the parameter changes**

4. Verify the scan tool Left Rear Door Ajar Switch parameter changes between Inactive and Active when opening and closing the left rear door.

⇒ **If the parameter does not change**

Refer to Circuit/System Testing — Door Ajar Switch.

⇓ **If the parameter changes**

5. Verify the scan tool Right Rear Door Ajar Switch parameter changes between Inactive and Active when opening and closing the right rear door.

⇒ **If the parameter does not change**

Refer to Circuit/System Testing — Door Ajar Switch.

⇓ **If the parameter changes**

6. Verify the scan tool Rear Closure Ajar Switch parameter changes between Inactive and Active when opening and closing the liftgate.

⇒ **If the parameter does not change**

Refer to Circuit/System Testing — Liftgate Ajar Switch.

⇓ **If the parameter changes**

7. All OK.

Circuit/System Testing

Door Ajar Switch

1. Vehicle OFF, disconnect the harness connector at the appropriate B28 Door Ajar Switch. Vehicle in Service Mode
2. Verify the appropriate scan tool Door Ajar Switch parameter is Inactive.

⇒ **If not Inactive**

2.1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

2.2. Test for infinite resistance between the signal circuit terminal 1 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

3. Install a 3 A fused jumper wire between the signal circuit terminal 1 and ground.
4. Verify the scan tool Door Ajar Switch parameter is Active.

⇒ **If not Active**

4.1. Vehicle OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.

4.2. Test for less than 1 V between the signal circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

4.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

5. Test or replace the B28 Door Ajar Switch.

Liftgate Ajar Switch

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the A23C Liftgate Latch Assembly. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal A and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Rear Closure Ajar Switch parameter is Inactive.

⇒ **If not Inactive**

4.1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit terminal B and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal A and the ground circuit terminal B.

6. Verify the scan tool Rear Closure Ajar Switch parameter is Active.

⇒ **If not Active**

6.1. Vehicle OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

7. Test or replace the A23C Liftgate Latch Assembly.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Liftgate Latch Replacement on page 4-265*
- *Door Open Indicator Switch Replacement on page 4-256*
- *Control Module References on page 6-3* for Body Control Module replacement, programming and setup

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Power Door Lock Key Cylinder Switches Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Lock Signal	2	2	2	—
Unlock Signal	1	1	1	—
Ground	—	3	—	—

1. Key Cylinder Lock Function Inoperative
2. Key Cylinder Unlock Function Inoperative
3. Key Cylinder Switch Inoperative

Circuit/System Description

The body control module (BCM) monitors the voltage level of the key switch lock and unlock signal circuits. When the key is inserted into the driver door key cylinder and turned to the Lock or Unlock position, a switch within the key cylinder closes causing the voltage to drop within the key switch unlock signal circuit. The BCM will detect the drop in voltage will command the driver door to unlock or for all doors to lock.

Reference Information

Schematic Reference

Door Lock/Indicator Schematics on page 4-219

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Power Door Locks Description and Operation on page 4-283

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Circuit/System Verification

1. Verify the A23 Door Latch Assemblies LOCK when inserting the key into the driver door lock key cylinder and turning the key to the lock position.

⇒ **If the A23 door latch assemblies do not LOCK**

Refer to Circuit/System Testing.

⇓ **If the A23 Door Latch Assemblies LOCK**

2. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the A23D Door Latch Assembly-Driver. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal listed below and ground:
   - Ground circuit terminal B — left hand drive
   - Ground circuit terminal C — right hand drive

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Test for greater than 10 V between the signal circuit terminals listed below and ground:
   - Signal circuit terminal D — right hand drive
   - Signal circuit terminal B — right hand drive
   - Signal circuit terminal A — left hand drive
   - Signal circuit terminal C — left hand drive

⇒ **If 10 V or less**

4.1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

4.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If greater than 10 V**

5. Test or replace the A23D Door Latch Assembly-Driver.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the A23D Door Latch Assembly-Driver.
2. Test for infinite resistance between the terminals listed below with the switch in the open position:
   - Signal terminal D and ground terminal C — right hand drive
   - Signal terminal B and ground terminal C — right hand drive
   - Signal terminal A and ground terminal B — left hand drive
   - Signal terminal C and ground terminal B — left hand drive

⇒ **If less than infinite resistance**

Replace the A23D Door Latch Assembly-Driver.

⇓ **If infinite resistance**

3. Test for less than 2 Ω between the terminal listed below with the switch in the Lock position:
   - Signal terminal B and ground terminal C — right hand drive
   - Signal terminal C and ground terminal B — left hand drive

⇒ **If 2 Ω or greater**

Replace the A23D Door Latch Assembly-Driver.

⇓ **If less than 2 Ω**

4. Test for less than 2 Ω between the terminals listed below with the switch in the Unlock position:
   - Signal terminal D and ground terminal C — right hand drive
   - Signal terminal A and ground terminal B — left hand drive

⇒ **If 2 Ω or greater**

Replace the A23D Door Latch Assembly-Driver.

⇓ **If less than 2 Ω**

5. All OK

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Front Side Door Lock Replacement on page 4-268*
- *Control Module References on page 6-3* for BCM replacement, programming and setup

Power Door Locks Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
BCM B+	B3125 02, B3130 02, B3135 02	B3125 02, B3130 02, B3135 02	—	—
Driver Door Lock Switch Lock Signal	B3150 00	2	2	—
Driver Door Lock Switch Unlock Signal	B3140 00	3	3	—
Driver Door Lock Switch Ground	—	1	—	—
Passenger Door Lock Switch Lock Signal	B3150 00	4	4	—
Passenger Door Lock Switch Unlock Signal	B3140 00	5	5	—
Passenger Door Lock Switch Ground	—	6	—	—
Door Latch Control	B3125 02, B3130 02, B3135 02	B3125 04, B3130 04, B3135 04	B3125 01, B3130 01, B3135 01	—
Driver Door Lock Motor Lock Control	B3125 02, B3130 02, B3135 02	B3125 04, B3130 04, B3135 04	B3125 01, B3130 01, B3135 01	—
Door Lock Actuator Unlock Control	B3125 02, B3130 02, B3135 02	B3125 04, B3130 04, B3135 04	B3125 01, B3130 01, B3135 01	—

1. Driver Door Lock Switch Inoperative
2. Driver Door Lock Switch Lock Function Inoperative
3. Driver Door Lock Switch Unlock Function Inoperative
4. Passenger Door Lock Switch Lock Function Inoperative
5. Passenger Door Lock Switch Unlock Function Inoperative
6. Passenger Door Lock Switch Inoperative

Circuit/System Description

The body control nodule (BCM) supplies a 12 V signal to each of the door lock and door unlock signal circuits. When the door lock switches are in the open position, the voltage level in the signal circuit will be near 12 V. When any door lock switch is pressed to the lock or unlock position, the voltage level in the appropriate signal circuit will drop to 0 V and the BCM will detect the voltage drop and command the door latches to perform the requested lock or unlock command.

The BCM powers the reversible liftgate and door latch assemblies by providing battery positive voltage and ground to the appropriate lock and unlock control circuits of the liftgate and door latch assemblies. The lock and unlock control circuits of the liftgate, rear doors and passenger door latch assemblies are all connected together. When the door latch assemblies are not active, all actuator lock and unlock control circuits are supplied a floating voltage used by the BCM to perform diagnostic functions on the circuits. Transitioning of the lock actuators to the lock or unlocked position depends upon which control circuits receive voltage and which control circuits receive ground.

Reference Information

Schematic Reference

- *Door Lock/Indicator Schematics on page 4-219*
- *Release Systems Schematics on page 4-221*
- *Body Control System Schematics on page 11-14*

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Power Door Locks Description and Operation on page 4-283

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when pushing the appropriate switch on the S13D Door Lock Switch-Driver.

⇒ **If the parameter is always Inactive**

Refer to Circuit/System Testing — Door Lock Switch Inoperative.

⇒ **If the parameter changes between Inactive and Lock only**

Refer to Circuit/System Testing — Door Lock Switch Malfunction.

⇒ **If the parameter changes between Inactive and Unlock only**

Refer to Circuit/System Testing — Door Lock Switch Malfunction.

⇒ **If the parameter is always Lock**

Refer to Circuit/System Testing — Lock/Unlock Signal Circuit Test.

⇒ **If the parameter is always Unlock**

Refer to Circuit/System Testing — Lock/Unlock Signal Circuit Test.

⇓ **If the parameter changes**

3. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when pushing the appropriate switch on the S13P Door Lock Switch-Passenger.

⇒ **If the parameter is always Inactive**

Refer to Circuit/System Testing — Door Lock Switch Inoperative.

⇒ **If the parameter changes between Inactive and Lock only**

Refer to Circuit/System Testing — Door Lock Switch Malfunction.

⇒ **If the parameter changes between Inactive and Unlock only**

Refer to Circuit/System Testing — Door Lock Switch Malfunction.

⇒ **If the parameter is always Lock**

Refer to Circuit/System Testing — Lock/Unlock Signal Circuit Test.

⇒ **If the parameter is always Unlock**

Refer to Circuit/System Testing — Lock/Unlock Signal Circuit Test.

⇓ **If the parameter changes**

4. Verify all vehicle doors and liftgate lock and unlock when commanding the All Doors Lock/Unlock with a scan tool.

⇒ **If only the driver door does not lock and unlock**

Refer to Circuit/System Testing – Driver Door Lock Malfunction.

⇒ **If one or more passenger doors or the liftgate does not lock and unlock**

Refer to Circuit/System Testing – Passenger Door Lock Malfunction.

⇒ **If the liftgate and all doors do not lock and unlock**

Refer to Circuit/System Testing – All Door Lock Inoperative.

⇓ **If all doors lock and unlock**

5. All OK.

Circuit/System Testing

Door Lock Switch Inoperative

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate S13 Door Lock Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Test or replace the S13 Door Lock Switch.

Door Lock Switch Malfunction

1. Vehicle OFF, disconnect the harness connector at the appropriate S13 Door Lock Switch. Vehicle in Service Mode
2. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 3.
3. Verify the scan tool Door Lock Switch parameter is Unlock.

⇒ **If not Unlock**

3.1. Vehicle OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.

3.2. Test for less than 1 V between the signal circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

3.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Unlock**

4. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the ground circuit terminal 3.
5. Verify the scan tool Door Lock Switch parameter is Lock.

⇒ **If not Lock**

5.1. Vehicle OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.

5.2. Test for less than 1 V between the signal circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

5.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Lock**

6. Test or replace the S13 Door Lock Switch.

Lock/Unlock Signal Circuit Test

1. Vehicle OFF, disconnect the harness connector at the S13D Door Lock Switch-Driver and the S13P Door Lock Switch-Passenger. Vehicle in Service Mode.
2. Verify the scan tool Door Lock Switch parameter is Inactive.

⇒ **If not Inactive**

2.1. Vehicle OFF, disconnect the X6 and X7 harness connectors at the K9 Body Control Module.

2.2. Test for infinite resistance between the signal circuit terminal listed below and ground.

- Signal circuit terminal 2
- Signal circuit terminal 4

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance, replace the K9 Body Control Module

⇓ **If Inactive**

3. Connect the harness connector at the S13P Door Lock Switch-Passenger.
4. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when pushing the appropriate switch on the S13P Door Lock Switch-Passenger.

⇒ **If Lock**

Test or replace the S13P Door Lock Switch-Passenger.

⇒ **If Unlock**

Test or replace the S13P Door Lock Switch-Passenger.

⇓ **If the parameter changes**

5. Connect the harness connector at the S13D Door Lock Switch-Driver.
6. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when pushing the appropriate switch on the S13D Door Lock Switch-Driver.

⇒ **If Lock**

Test or replace the S13D Door Lock Switch-Driver.

⇒ **If Unlock**

Test or replace the S13D Door Lock Switch-Driver.

⇓ **If the parameter changes**

7. All OK.

Driver Door Lock Malfunction

1. Vehicle OFF, disconnect the X6 harness connector at the K9 Body Control Module, Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit terminal 1 and ground.

⇒ **If 1 V or greater**

2.1. Vehicle OFF, disconnect the harness connector at the A23D Door Latch Assembly – Driver, Vehicle in Service Mode.

2.2. Test for less than 1 V between the control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ **If less than 1 V**

3. Vehicle OFF, connect the X6 harness connector at the K9 Body Control Module. Disconnect the harness connector at the A23D Door Latch Assembly–Driver, Vehicle in Service Mode.

Note: Leaving the DMM connected between a control circuit and ground for greater than 20 s may cause the K9 Body Control Module to interpret the test as a system fault and will cause the voltage on the control circuit to drop to 0 V. If the voltage drops to 0 V, operate the door locks using the door lock switch to restore the voltage for testing.

4. Test for greater than 3 V between the control circuit terminals listed below and ground:
   - Control circuit terminal A
   - Control circuit terminal B

⇒ **If 3 V or less**

4.1. Vehicle OFF, disconnect the X6 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance on the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If greater than 3 V**

Note: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 00.00 V.

5. Install a DMM between the control circuit terminal A and control circuit terminal B Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 00.00 V.
6. Lock and unlock the vehicle doors using the S13D Door Lock Switch-Driver.
7. Verify the MAX voltage captured by the DMM is greater than 10 V.

⇒ **If 10 V or less**

Replace the K9 Body Control Module.

⇓ **If greater than 10 V**

8. Test or replace the A23D Door Latch Assembly–Driver.

Passenger Door Lock Malfunction

1. Vehicle OFF, disconnect the X6 harness connector at the K9 Body Control Module, Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit terminal 2 and ground.

⇒ **If 1 V or greater**

2.1. Vehicle OFF, disconnect the harness connector at the A23P Door Latch Assembly – Passenger, A23LR Door Latch Assembly – Left Rear, A23RR Door Latch Assembly – Right Rear and M14B Door Lock Actuator-Liftgate, Vehicle in Service Mode.

2.2. Test for less than 1 V between the control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ **If less than 1 V**

3. Vehicle OFF, connect the X6 harness connector at the K9 Body Control Module. Disconnect the harness connector at the appropriate M14B Door Lock Actuator-Liftgate, or the A23P Door Latch Assembly-Passenger or A23 Door Latch Assembly-Rear.

Note: Leaving the DMM connected between a control circuit and ground for greater than 20 s may cause the K9 Body Control Module to interpret the test as a system fault and will cause the voltage on the control circuit to drop to 0 V. If the voltage drops to 0 V, operate the door locks using the door lock switch to restore the voltage for testing.

4. Test for greater than 3 V between the control circuit terminal listed below and ground:
   - A23P Door Latch Assembly-Passenger — control circuit terminal A
   - A23P Door Latch Assembly-Passenger — control circuit terminal B
   - A23RR Door Latch Assembly-Right Rear — control circuit terminal A
   - A23RR Door Latch Assembly-Right Rear — control circuit terminal B
   - A23LR Door Latch Assembly-Left Rear — control circuit terminal A
   - A23LR Door Latch Assembly-Left Rear — control circuit terminal B
   - M14B Door Lock Actuator-Liftgate — control circuit terminal 1
   - M14B Door Lock Actuator-Liftgate — control circuit terminal 2

⇒ **If 3 V or less**

4.1. Vehicle OFF, disconnect the X6 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance on the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If greater than 3 V**

Note: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 00.00 V.

5. Install a DMM between the control circuits listed below. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 00.00 V.
   - A23P Door Latch Assembly-Passenger – control circuit terminal A and control circuit terminal B
   - A23RR Door Latch Assembly-Right Rear – control circuit terminal A and control circuit terminal B

- A23LR Door Latch Assembly-Left Rear – control circuit terminal A and control circuit terminal B
- M14B Door Lock Actuator-Liftgate — control circuit terminal 1 and control circuit terminal 2

6. Lock and unlock the vehicle doors using the door lock switch.
7. Verify the MAX voltage captured by the DMM is greater than 10 V.

⇒ **If 10 V or less**

Replace the K9 Body Control Module.

⇓ **If greater than 10 V**

8. Test or replace the A23 Door Latch Assembly or M14B Door Lock Actuator-Liftgate.

All Door Locks Inoperative

1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, Vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

2.1. Vehicle OFF.

2.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

2.3. Disconnect the harness connector at each of the A23 Door Latch Assemblies and the M14B Door Lock Actuator-Liftgate.

2.4. Test for infinite resistance between each control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the appropriate A23 Door Latch Assembly or M14B Door Lock Actuator-Liftgate.

⇓ **If the test lamp illuminates**

3. Vehicle OFF, connect the X2 harness connector at the K9 Body Control Module. Disconnect the X6 harness connector at the K9 Body Control Module, Vehicle in Service Mode.
4. Test for less than 1 V between the control circuit terminals listed below and ground:
   - Control circuit terminal 1 X6
   - Control circuit terminal 2 X6
   - Control circuit terminal 4 X6

⇒ **If 1 V or greater**

4.1. Vehicle OFF, disconnect the harness connector at the A23D Door Latch Assembly – Driver, A23P Door Latch Assembly – Passenger, A23LR Door Latch Assembly – Left Rear, A23RR Door Latch Assembly – Right Rear and M14B Door Lock Actuator-Liftgate, Vehicle in Service Mode.

4.2. Test for less than 1 V between the control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ **If less than 1 V**

5. Test for infinite resistance between the control circuit terminals listed below and ground:
   - Control circuit terminal 1 X6
   - Control circuit terminal 2 X6
   - Control circuit terminal 4 X6

⇒ **If less than infinite resistance**

5.1. Vehicle OFF, disconnect the harness connector at the A23D Door Latch Assembly – Driver, A23P Door Latch Assembly – Passenger, A23LR Door Latch Assembly – Left Rear, A23RR Door Latch Assembly – Right Rear and M14B Door Lock Actuator-Liftgate.

5.2. Test for less than infinite resistance between the control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ **If infinite resistance**

6. Test for less than 10 Ω between the control circuit terminal 1 and the control circuit terminal 4.

⇒ **If 10 Ω or greater**

6.1. Vehicle OFF, disconnect the harness connector at the A23D Door Latch Assembly – Driver.

6.2. Test for less than 2 Ω between the K9 Body Control Module control circuit terminal 4 and the A23D Door Latch Assembly – Driver control circuit terminal A.

⇒ If 2 Ω or greater, repair the open/high resistance on the circuit.

⇓ **If less than 10 Ω**

7. Test or replace the K9 Body Control Module.

Component Testing

Door Lock Switch

1. Vehicle OFF, disconnect the harness connector at the appropriate S13 Door Lock Switch.
2. Test for infinite resistance between the signal terminal 2 and the ground terminal 3 with the switch in the center position.

⇒ **If less than infinite resistance**

Replace the S13 Door Lock Switch.

⇓ **If infinite resistance**

3. Test for infinite resistance between the signal terminal 4 and the ground terminal 3 with the switch in the center position.

⇒ **If less than infinite resistance**

Replace the S13 Door Lock Switch.

⇓ **If infinite resistance**

4. Test for less than 2 Ω between the signal terminal 4 and the ground terminal 3 with the switch in the Lock position.

⇒ **If 2 Ω or greater**

Replace the S13 Door Lock Switch.

⇓ **If less than 2 Ω**

5. Test for less than 2 Ω between the signal terminal 2 and the ground terminal 4 with the switch in the Unlock position.

⇒ **If 2 Ω or greater**

Replace the S13 Door Lock Switch.

⇓ **If less than 2 Ω**

6. All OK

Door Latch Assembly

1. Vehicle OFF, disconnect the harness connector at the appropriate A23 Door Latch Assembly.
2. Install a 25 A fused jumper wire between one of the control terminals and 12 V. Momentarily install a jumper wire between the other control terminal and ground. Reverse the jumper wires at least two times, the A23 Door Latch Assembly should perform the LOCK and UNLOCK function.

⇒ **If the actuator does not perform the LOCK and UNLOCK function**

Replace the A23 Door Latch Assembly.

⇓ **If the actuator performs the LOCK and UNLOCK function**

3. All OK

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Front Side Door Lock Replacement on page 4-268*
- *Rear Side Door Lock Replacement on page 4-269*
- *Door Lock Switch Replacement on page 4-281*
- *Control Module References on page 6-3* for body control module replacement, programming and setup

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Trunk/Liftgate Lock Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
BCM B+	B3125 02, B3130 02, B3135 02	B3125 02, B3130 02, B3135 02	—	—
Lock Signal	B3150 00	1	1	—
Unlock Signal	B3140 00	2	2	—
Ground	—	3	—	—
Lock Control	B3125 02, B3130 02, B3135 02	B3125 04, B3130 04, B3135 04	B3125 01, B3130 01, B3135 01	—
Unlock Control	B3125 02, B3130 02, B3135 02	B3125 04, B3130 04, B3135 04	B3125 01, B3130 01, B3135 01	—

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
1. Liftgate Lock Switch Lock Function Inoperative 2. Liftgate Lock Switch Unlock Function Inoperative 3. Liftgate Lock Switch Lock and Unlock Functions Inoperative				

Circuit/System Description

When the vehicle does not have power door locks, it will be provided with a Liftgate Unlatch Switch to lock or unlock the liftgate. The body control module (BCM) monitors the voltage level of the liftgate lock and liftgate unlock signal circuits. When the Liftgate Unlatch Switch is in the open position, the voltage level in the signal circuit will be near 0 V. When the Liftgate Unlatch Switch is pressed to the lock or unlock position, a signal will be sent to the BCM requesting a lock or unlock. command. When the liftgate lock actuator is not active, both lock and unlock control circuits are supplied a floating voltage by the BCM. Transitioning of the liftgate lock actuator to the lock or unlocked position depends upon which control circuits receive voltage and which control circuits receive ground

Reference Information

Schematic Reference

- *Release Systems Schematics on page 4-221*
- *Body Control System Schematics on page 11-14*

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Rear Hatch/Gate Description and Operation on page 4-285

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Door Lock Switch parameter changes from Inactive to Lock and Unlock when cycling the S46B Liftgate Unlatch Switch between LOCK and UNLOCK.

⇒ **If the parameter does not change**

Refer to Circuit/System Testing — Liftgate Unlatch Switch Malfunction

⇓ **If the parameter changes**

3. Verify the M14B Door Lock Actuator-Liftgate will LOCK and UNLOCK when commanding the All Doors Lock/Unlock with a scan tool.

⇒ **If the M14B Door Lock Actuator-Liftgate LOCK or UNLOCK functions do not work**

Refer to Circuit/System Testing — Liftgate Lock Actuator Malfunction.

⇓ **If the M14B Door Lock Actuator-Liftgate LOCK and UNLOCK function works**

4. All OK.

Circuit/System Testing

Liftgate Unlatch Switch Malfunction

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S46B Liftgate Unlatch Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Door Lock Switch parameter is Inactive.

⇒ **If not Inactive**

4.1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit terminal 2 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

4.3. Test for infinite resistance between the signal circuit terminal 3 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ground circuit terminal 4.

6. Verify the scan tool Door Lock Switch parameter is Unlock.

⇒ **If not Unlock**

6.1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit terminal 3 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Unlock**

7. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 4.
8. Verify the scan tool Door Lock Switch parameter is Lock.

⇒ **If not Lock**

8.1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.

8.2. Test for less than 1 V between the signal circuit terminal 2 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

8.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Lock**

9. Test or replace the S46B Liftgate Unlatch Switch.

Liftgate Lock Actuator Malfunction

1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, Vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

2.1. Vehicle OFF.

2.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

2.3. Disconnect the harness connector at the M14B Door Lock Actuator-Liftgate.

2.4. Test for infinite resistance between each control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the M14B Door Lock Actuator-Liftgate.

⇓ **If the test lamp illuminates**

3. Vehicle OFF, disconnect the harness connector at the M14B Door Lock Actuator-Liftgate.
4. Connect a test lamp between the control circuit terminal 1 and control circuit terminal 2, Vehicle in Service Mode.
5. Verify the test lamp turns ON and OFF when commanding the Lock and Unlock states with a scan tool.

⇒ **If the test lamp is always OFF**

5.1. Vehicle OFF, remove the test lamp, disconnect the X6 harness connector at the K9 Body Control Module.

5.2. Test for infinite resistance between each control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

5.3. Test for less than 2 Ω in each control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If the test lamp is always ON**

5.1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.

5.2. Test for less than 1 V between the control circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If the test lamp turns ON and OFF**

6. Test or replace the M14B Door Lock Actuator-Liftgate.

Component Testing

Liftgate Unlatch Switch

1. Vehicle OFF, disconnect the harness connector at the S46B Liftgate Unlatch Switch.
2. Test for infinite resistance between the signal terminal 2 and the ground terminal 4 with the switch in the open position.

⇒ **If less than infinite resistance**

Replace the S46B Liftgate Unlatch Switch.

⇓ **If infinite resistance**

3. Test for infinite resistance between the signal terminal 3 and the ground terminal 4 with the switch in the open position.

⇒ **If less than infinite resistance**

Replace the S46B Liftgate Unlatch Switch.

⇓ **If infinite resistance**

4. Test for less than 2 Ω between the signal terminal 2 and the ground terminal 4 with the switch in the Lock position.

⇒ **If 2 Ω or greater**

Replace the S46B Liftgate Unlatch Switch.

⇓ **If less than 2 Ω**

5. Test for less than 2 Ω between the signal terminal 3 and the ground terminal 4 with the switch in the Unlock position.

⇒ **If 2 Ω or greater**

Replace the S46B Liftgate Unlatch Switch.

⇓ **If less than 2 Ω**

6. All OK

Liftgate Lock Actuator

1. Vehicle OFF, disconnect the harness connector at the M14B Door Lock Actuator-Liftgate.
2. Install a 25 A fused jumper wire between one of the control terminals and 12 V. Momentarily install a jumper wire between the other control terminal and ground. Reverse the jumper wires at least two times, the M14B Door Lock Actuator-Liftgate should perform the LOCK and UNLOCK function.

⇒ **If the actuator does not perform the LOCK and UNLOCK function**

Replace the M14B Door Lock Actuator-Liftgate.

⇓ **If the actuator performs the LOCK and UNLOCK function**

3. All OK

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Instrument Panel Trim Plate Applique Replacement - Left Side on page 2-24*
- *Control Module References on page 6-3* for BCM replacement, programming and setup

Door Will Not Open/Close, Door Binding, or Locks, Handles, or Cylinders Do Not Function

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to address the mechanical diagnosis of the door latching system, which could include the inside and outside handles, latch rods/cables, latches, or latch cylinders.			
1	Did you perform the Diagnostic System Check – Vehicle?	Go to *Step 2*	Go to *Diagnostic System Check - Vehicle on page 6-91*
2	Were you sent here from a Vehicle Access Symptom Table?	Go to *Step 3*	Go to *Symptoms - Vehicle Access on page 4-237*
3	Does the door open with the outside handle?	Go to *Step 4*	Go to *Step 10*
4	Does the door open with the inside handle?	Go to *Step 5*	Go to *Step 11*
5	Does the manual latch knob latch and unlatch the latch smoothly without binding?	Go to *Step 6*	Go to *Step 12*
6	Does the door latch switch and/or the keyless entry transmitter latch and unlatch the door latch or door latches?	Go to *Step 7*	Go to *Step 14*
7	Is the outside key cylinder loose or does it rattle or fall out? (if equipped)	Go to *Step 15*	Go to *Step 8*
8	Does the outside key cylinder latch and unlatch the latch and function smoothly without binding? (if equipped)	Go to *Step 9*	Go to *Step 16*
9	Does the door bind, does it take excessive effort to open, or is it misaligned?	Go to *Step 17*	Go to *Step 18*

Door Will Not Open/Close, Door Binding, or Locks, Handles, or Cylinders Do Not Function (cont'd)

Step	Action	Yes	No
10	If the door will not open with the outside handle, or the handle is obstructed or loose, check the following: • For cold weather freezing, thaw as necessary. • Check the handle for foreign material. Remove material as necessary. • Check the handle grab bar for looseness or damage. Repair as necessary. • Check the handle for full travel. If the issue is not resolved, remove the trim panel as necessary to gain access to door hardware and check the following: • Check the handle chassis for loose fasteners, broken chassis inserts, loose or missing spring, or a loose, missing or bent rod lever. • Check for bent rod to the outside handle. • Check that the handle grab bar engages the rod lever properly. • Check for interference of rod and handle to other components in the door. • Check that handle rod is securely attached at both latch and handle. • Check if rod is positioned properly in the clip on the latch. At rest position, the handle should be fully against the down stop and the latch lever should be at the bottom of its travel. Correct by opening clip, repositioning rod in clip and closing clip till it snaps, as necessary. Did you find and correct the condition?	Go to *Step 18*	Go to *Step 11*
11	Door will not open with the inside handle: • Check the inside handle for foreign material. Remove material as necessary. • Check that the handle is secure. Correct as necessary. • If rear door, verify child security is not engaged. • Remove the trim panel as necessary to and check the inside handle rod/cable attachments at both the latch and handle. If the cable is kinked or pinched, correct as necessary. Did you find and correct the condition?	Go to *Step 18*	Go to *Step 12*
12	The door will not or is difficult to unlatch with the inside manual latch knob: • For cold weather freezing, thaw as necessary • Check the latch knob for a loose condition. Repair or replace as necessary. Check the latch knob for binding or dragging using the following procedure: 1. Remove the latch knob. 2. If condition goes away, check for drag/interference of the latch knob against the inner belt seal, or the trim panel. Correct as required. If further action is required, remove the trim panel and check the latch rod and latch knob for interference with the following: • Water deflector/paper • Side impact foam • Rod grommet in sheet metal • Glass run channel • Other rods or cables • Trim panel Did you find and correct the condition?	Go to *Step 18*	Go to *Step 13*

Door Will Not Open/Close, Door Binding, or Locks, Handles, or Cylinders Do Not Function (cont'd)

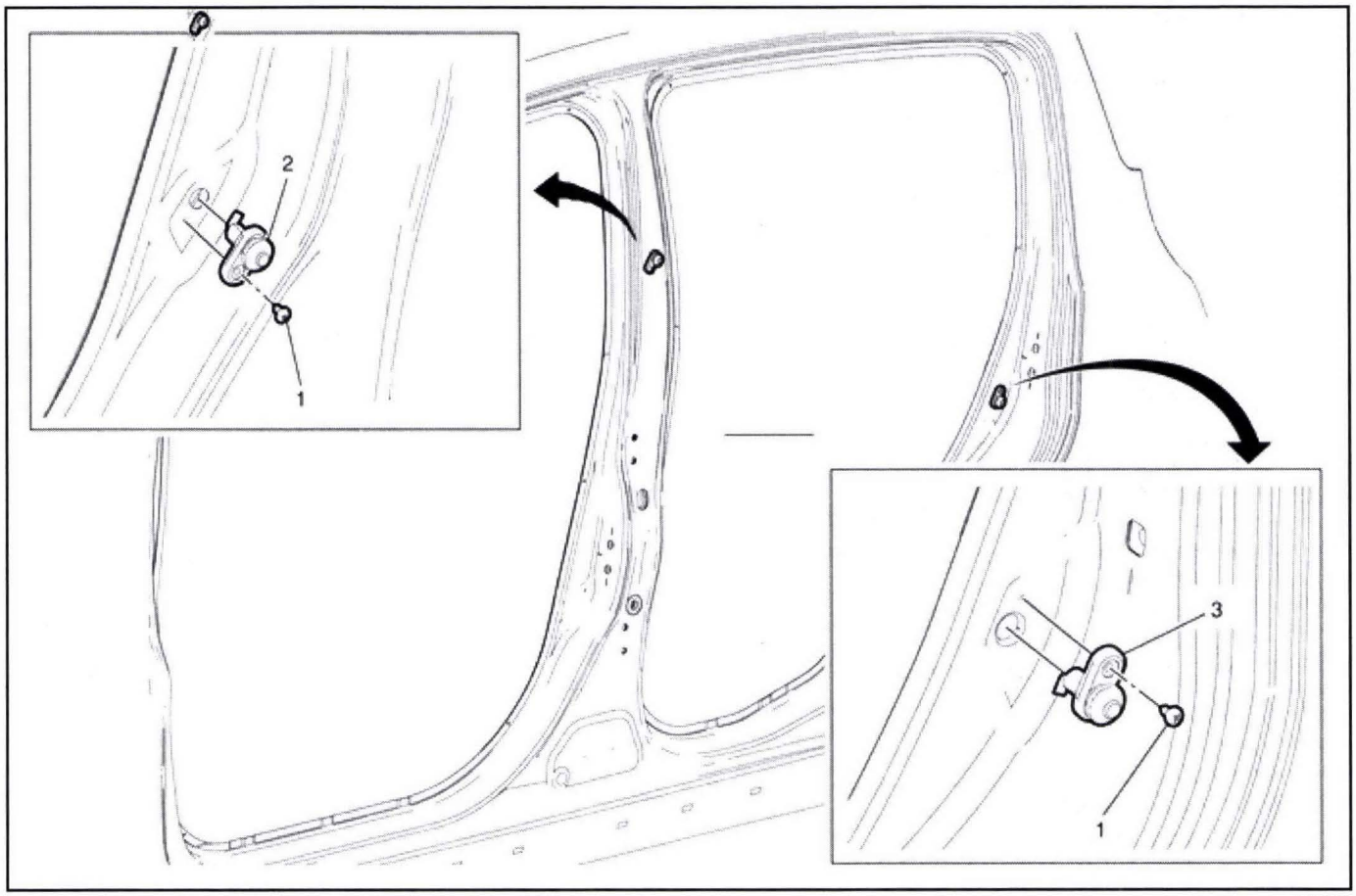
Step	Action	Yes	No
13	With a manual lock, if the latch will not function properly do the following: 1. Function the lock/unlatch lever on the latch to unlatch the latch. Check for high internal resistance. 2. With the door open, manually close the latch with a screwdriver. 3. Check the latch for internal binding by actuating the latch with the inside door handle lever. 4. Manually close the latch with a screwdriver again. 5. Check the latch for internal binding by actuating the latch with the outside door handle lever. Did you find and correct the condition?	Go to *Step 18*	Go to *Step 14*
14	If power locks are included in vehicle options and do not function with either the keyless entry transmitter or switch: 1. For cold weather freezing, thaw as necessary. 2. Remove trim pad as required and check the following: • Verify door harness has appropriate power connectors for switches and latch. • Check harness connector pins for corrosion. • Assure wire harness connectors are seated and locked properly at latch and switch. Remove and re-seat if required. • Check door harness for cuts/chafing/corrosion. Correct/replace as required. • Check for 12V at latch and door switch. Correct/proceed accordingly. • Check BCM for trouble codes. Correct/proceed accordingly. 3. If power locks still do not function do the following: 3.1. Remove latch from door cavity. 3.2. Connect latch to electrical connector outside the door. 3.3. Function power lock/unlatch switch in both latch and unlatch directions. Watch for lock/unlatch lever on latch to move completely from one position to the other. 3.4. If lever does not move, remove connector from old latch and attach to new latch outside of door cavity. 3.5. Verify new latch is functional, if so, attach rods and install new latch in door. Did you find and correct the condition?	Go to *Step 18*	Go to *Step 15*
15	If the key cylinder is loose do the following: • Remove the trim if necessary. • Check that the retaining clip is properly seated. (if equipped) • Check that the fastener is properly torqued. (if equipped) Did you find and correct the condition?	Go to *Step 18*	Go to *Step 16*

Door Will Not Open/Close, Door Binding, or Locks, Handles, or Cylinders Do Not Function (cont'd)

Step	Action	Yes	No
16	The outside key cylinder will not latch and unlatch the latch and function smoothly without binding: 1. For cold weather freezing, thaw as necessary 2. Remove trim if required. 3. Check that the key cylinder rod is securely attached both to the key cylinder pawl and the latch. 4. Check that key cylinder lever, rod and latch lever are free of interferences. Remove interferences as required. 5. Check that latch cylinder rod is routed properly. Re-route as required. 6. Remove rod from latch cylinder and actuate cylinder. Check for internal resistance. Lubricate latch cylinder as required 7. Verify Cylinder rotates with vehicle key. If not, code and replace cylinder to match vehicle key. See latch cylinder coding and replacing. Did you find and correct the condition?	Go to *Step 18*	Go to *Step 17*
17	The door is difficult to open: • Check for interference with the fender, adjacent door, body opening or door striker and adjust as necessary. • Check for binding door hinges. Lubricate or align/adjust as necessary. • Check the door check link for binding. Lubricate as necessary. • Adjust the door as necessary. Did you find and correct the condition?	Go to *Step 18*	Go to appropriate Door Lock Striker Adjustment procedure.
18	Verify proper operation of the door closing system. • Outside handle • Inside handle • Manual lock/unlatch – Outside key cylinder – Inside latch knob – Double pull handle • Power lock/unlatch – Key fob – Door switches • Door opening/closing effort Is the condition still present?	Go to *Step 1*	System OK

Repair Instructions

Door Open Indicator Switch Replacement

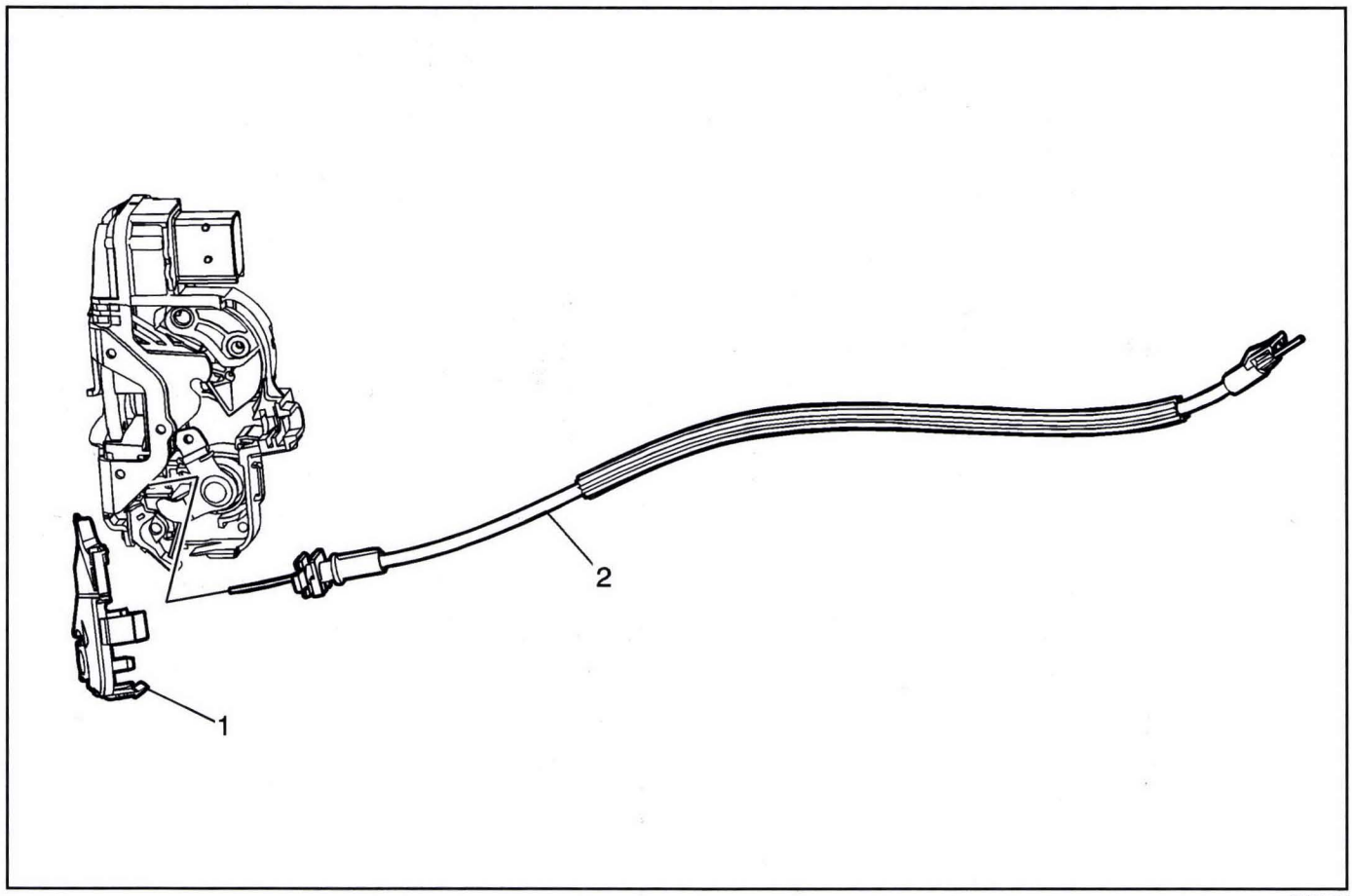


3972812

Door Open Indicator Switch Replacement

Callout	Component Name
1	Door Ajar Switch Screw **Caution:** Refer to *Fastener Caution on page 0-8.* **Tighten** 0.8 N•m (7 lb in)
2	Door Ajar Switch-Front **Procedure** 1. Remove the door ajar switch from the body panel. 2. Disconnect the door ajar switch electrical connector.
3	Door Ajar Switch-Rear **Procedure** 1. Remove the door ajar switch from the body panel. 2. Disconnect the door ajar switch electrical connector.

Rear Side Door Inside Handle Cable Replacement



2260494

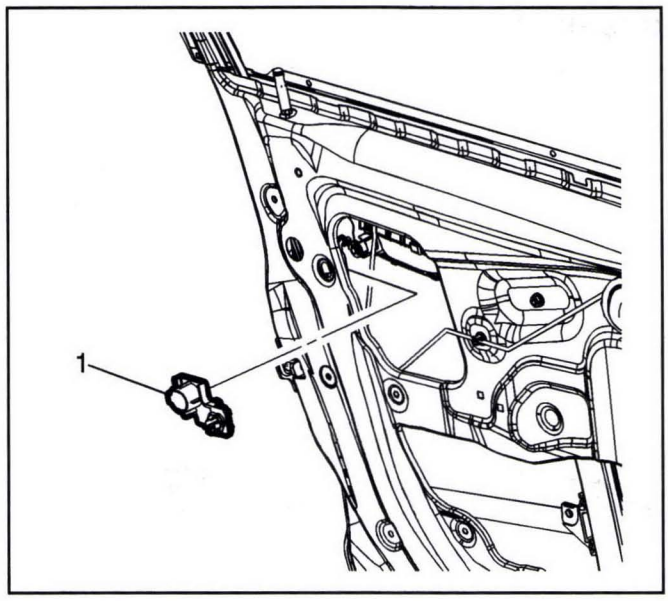
Rear Side Door Inside Handle Cable Replacement

Callout	Component Name
Preliminary Procedure Remove the rear side door lock. Refer to *Rear Side Door Lock Replacement on page 4-269*.	
1	Rear Side Door Inside Handle Cable Cover **Note:** Open the inside handle cable cover to access the release.
2	Rear Side Door Inside Handle Cable **Procedure** Disconnect the inside handle cable from the inside door handle. **Note:** Inspect the door lock system for proper operation before installing the door trim panel.

Front Side Door Lock Cylinder Replacement

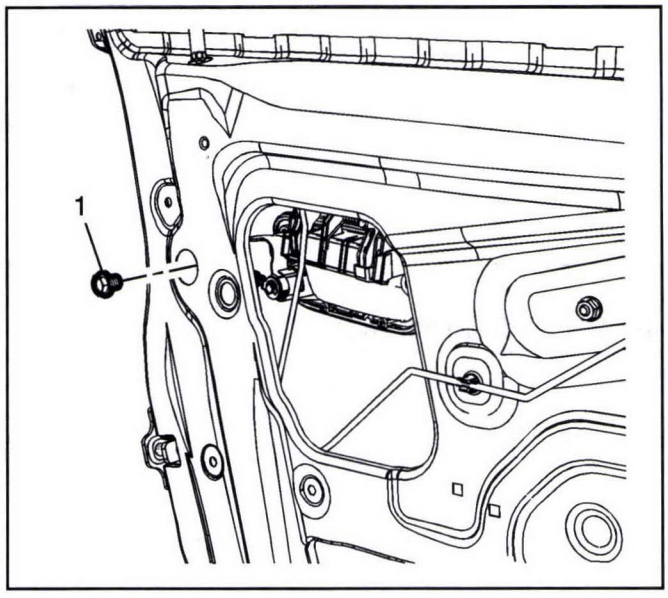
Removal Procedure

1. Remove the front side door trim. Refer to *Front Side Door Trim Replacement on page 2-53*.
2. Remove the water deflector.
3. Remove the front side door lock cylinder rod.



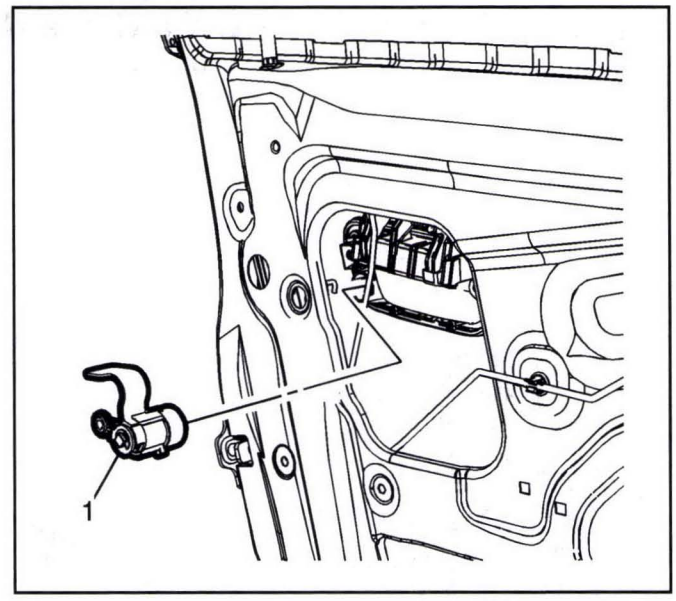
2309071

4. Remove the front side door lock rod holder (1).



2309073

5. Remove the front side door lock cylinder bolt (2).

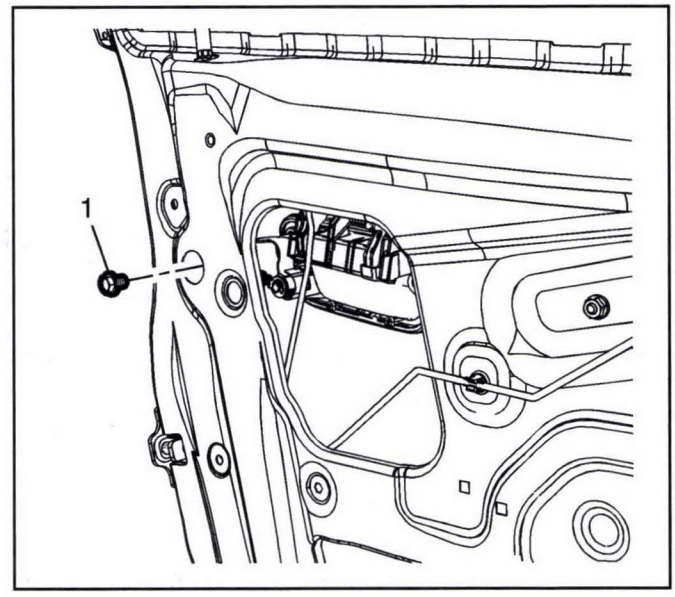


2309074

6. Remove the front side door lock cylinder (3).

Installation Procedure

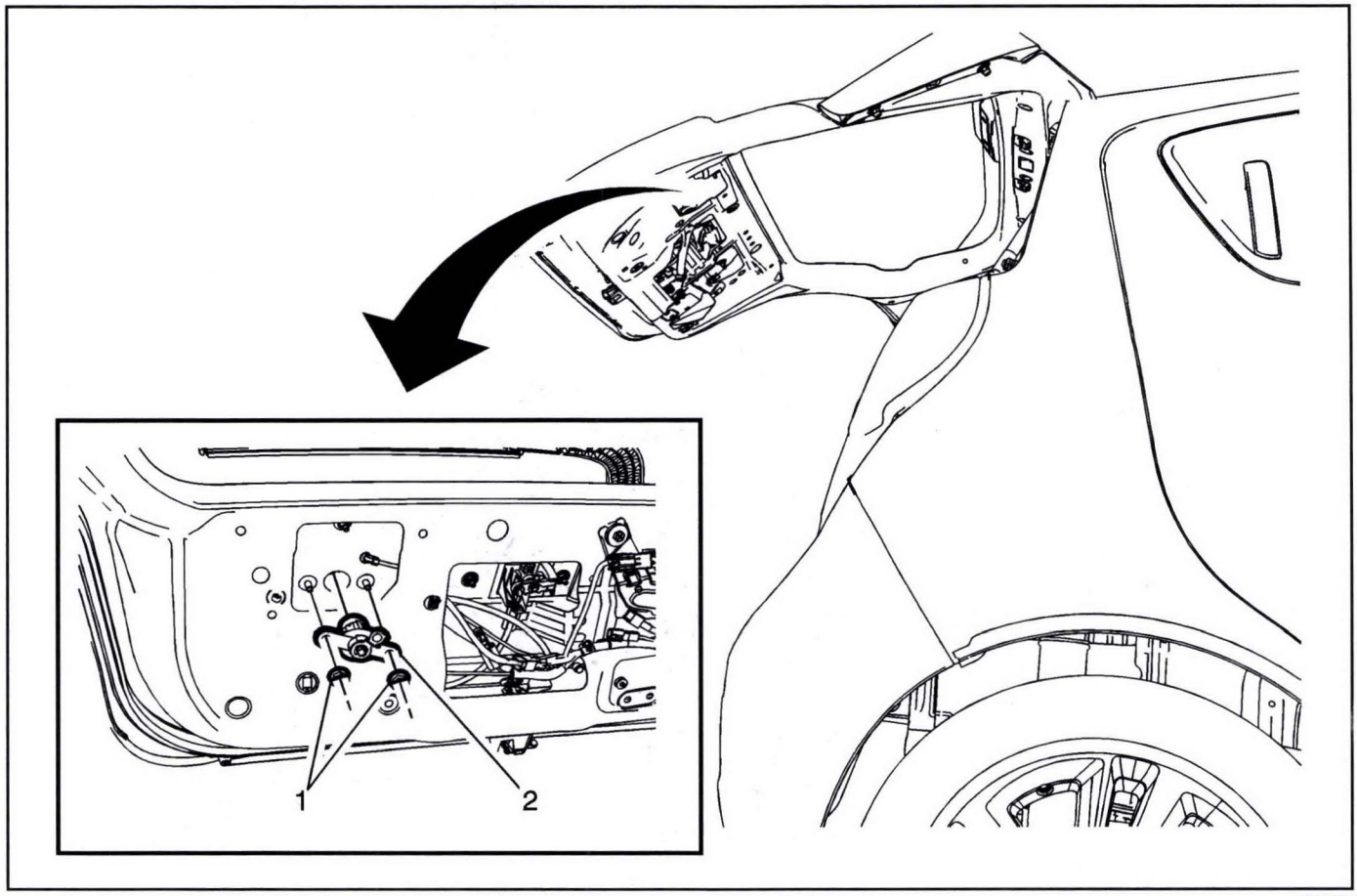
1. Install the front side door lock cylinder.



2309073

2. Install the front side door lock cylinder bolt (2) and tighten to **4.5** N•m **(40 lb in)**.
3. Install the front side door lock rod holder.

Liftgate Lock Cylinder Replacement

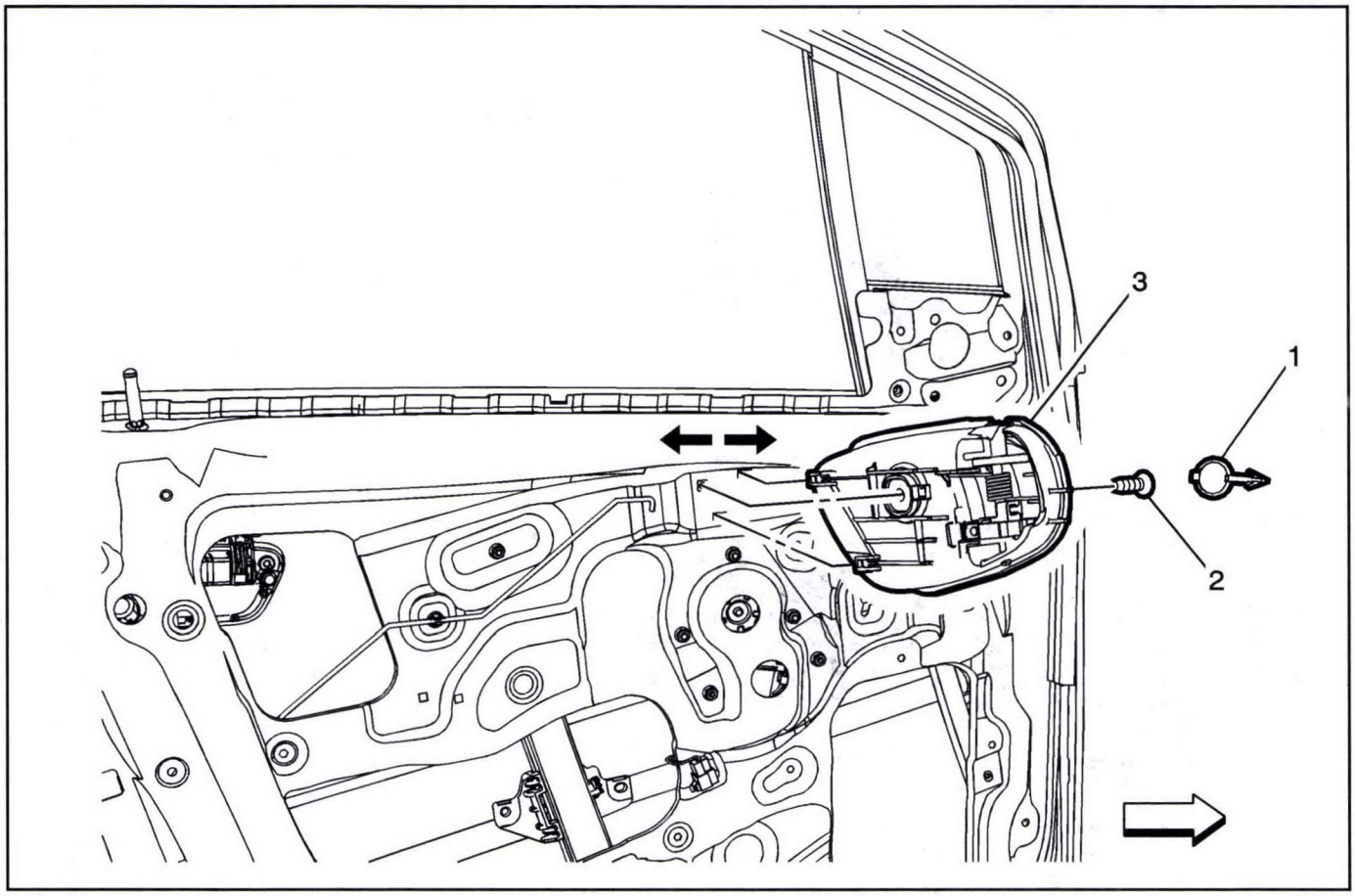


2920985

Liftgate Lock Cylinder Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the liftgate trim panel. Refer to *Liftgate Trim Finish Panel Replacement on page 2-70*. 2. Remove the liftgate lock cylinder rod.	
1	Liftgate Lock Cylinder Nut (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Liftgate Lock Cylinder Assembly **Note:** For coding the lock cylinder refer to *Rear Compartment Lid Lock Cylinder Coding on page 1-26*

Front Side Door Inside Handle Replacement

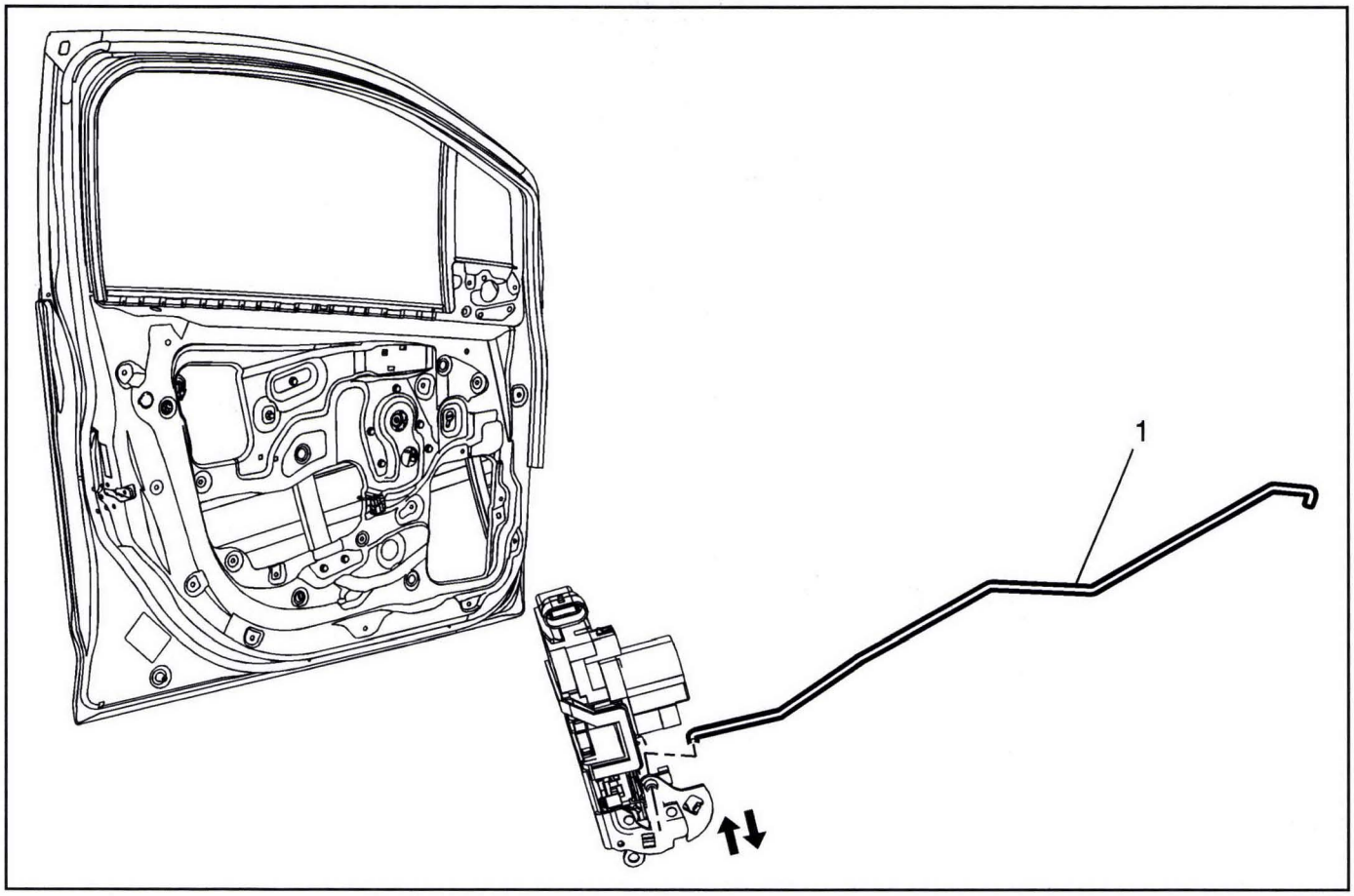


2920102

Front Side Door Inside Handle Replacement

Callout	Component Name
Preliminary Procedure Remove the front side door trim. Refer to *Front Side Door Trim Replacement on page 2-53*.	
1	Front Side Door Inside Handle Cap
2	Front Side Door Inside Handle Screw **Caution:** Refer to *Fastener Caution on page 0-8*. **Procedure** 1. Place the window in the full up position. 2. Remove the water deflector. 3. Release the front side door inside handle from the clip. **Tighten** 2 N•m (18 lb in)
3	Front Side Door Inside Handle **Procedure** Transfer components as necessary. **Note:** Inspect the door lock system for proper operation before installing the door trim.

Front Side Door Inside Handle Rod Replacement

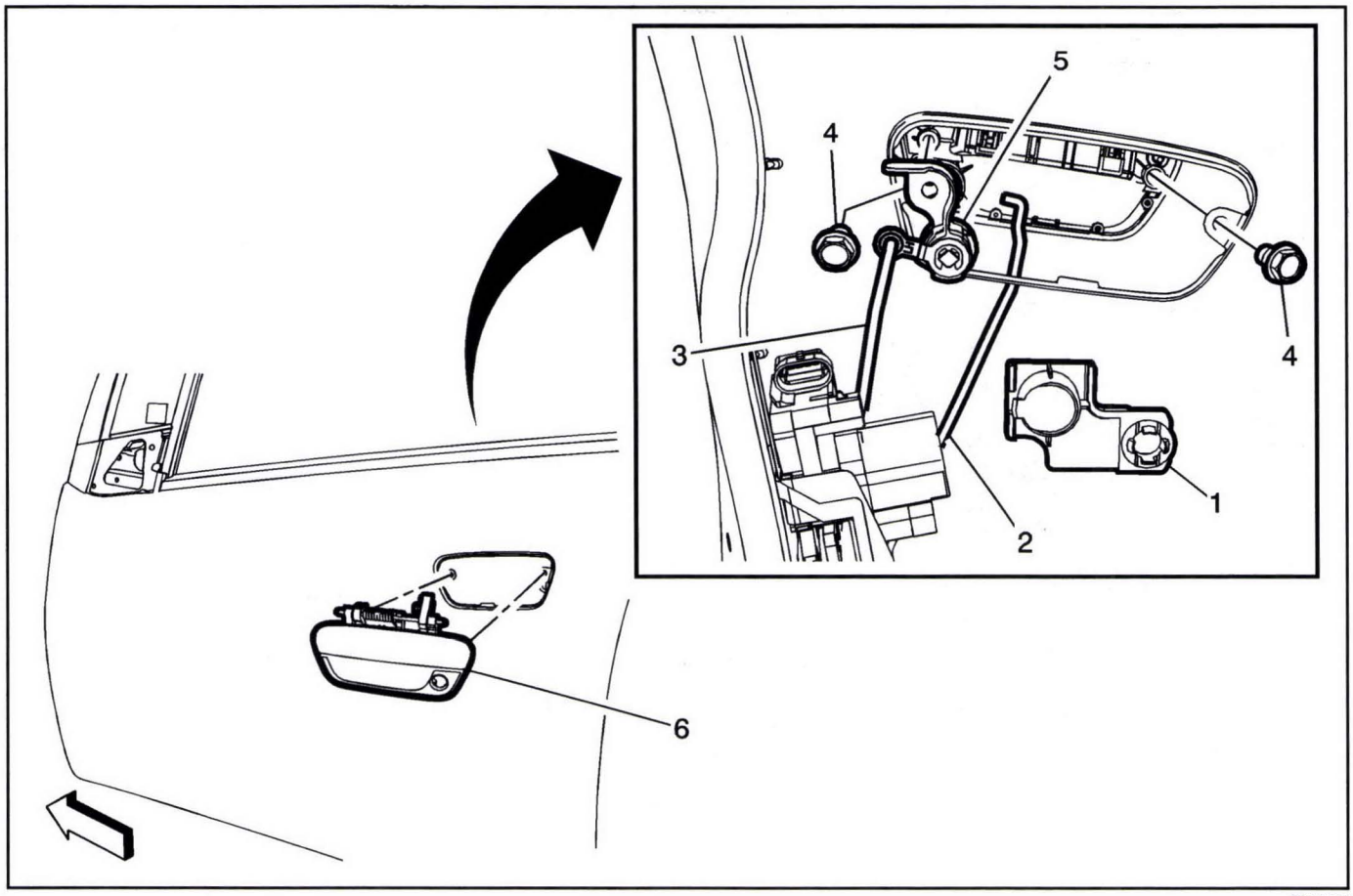


2920103

Front Side Door Inside Handle Rod Replacement

Callout	Component Name
Preliminary Procedure Remove the front side door lock. Refer to *Front Side Door Lock Replacement on page 4-268*.	
1	Front Side Door Inside Handle Rod **Note:** Inspect the door lock system for proper operation before installing the door trim.

Front Side Door Outside Handle Replacement



2921326

Front Side Door Outside Handle Replacement

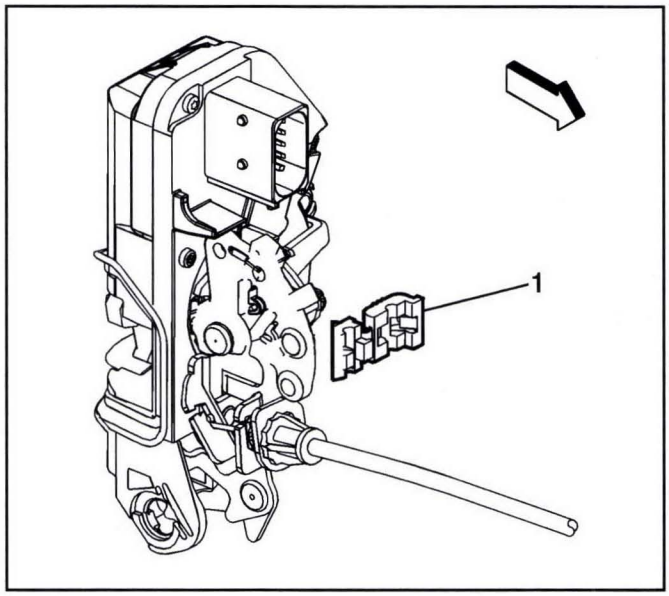
Callout	Component Name
Preliminary Procedures Remove the front side door trim. Refer to *Front Side Door Trim Replacement on page 2-53*.	
1	Front Side Door Lock Cylinder Holder **Procedure** Use a suitable tool, remove the front side door lock cylinder holder from the back of the cylinder by placing the tool between the handle and holder, turn the tool releasing the holder from the lock cylinder.
2	Front Side Door Outside Handle Rod **Procedure** 1. Remove the water deflector. 2. Use a suitable tool, unhook the handle rod from the handle.
3	Front Side Door Outside Lock Cylinder Rod
4	Front Side Door Outside Handle Bolt (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 4.5 N•m (40 lb in) **Note:** After the handle bolts have been removed the lock cylinder can be pulled rearward releasing it from the handle.
5	Front Side Door Outside Lock Cylinder

Front Side Door Outside Handle Replacement (cont'd)

Callout	Component Name
6	Front Side Door Outside Handle **Procedure** 1. After replacing the handle it necessary to do the following: 1.1. If the door handle rod clip was opened in this procedure it is necessary to replace the clip. Refer to *Front and Rear Side Door Outside Handle Rod Clip Replacement on page 4-263*. 1.2. Use a flat-head tool to open the lower clip from the threaded rod connecting the lock to the outside handle 1.3. Position the outside door handle rod in the clip in order to eliminate any free play in the handle. 1.4. Adjust the travel of the handle by removing the threaded rod from the lower clip. 1.5. In order to prevent outside handle lever pre-load, lock the outside handle shall be fully secured to the door prior to securing integral lock clip to outside handle rod. Integral lock clip shall be in the full up position while securing to outside handle rod. Refer to *Rear Side Door Outside Handle Rod Adjustment on page 4-276*. **Note:** Inspect the door lock system for proper operation before installing the door trim.

Front and Rear Side Door Outside Handle Rod Clip Replacement

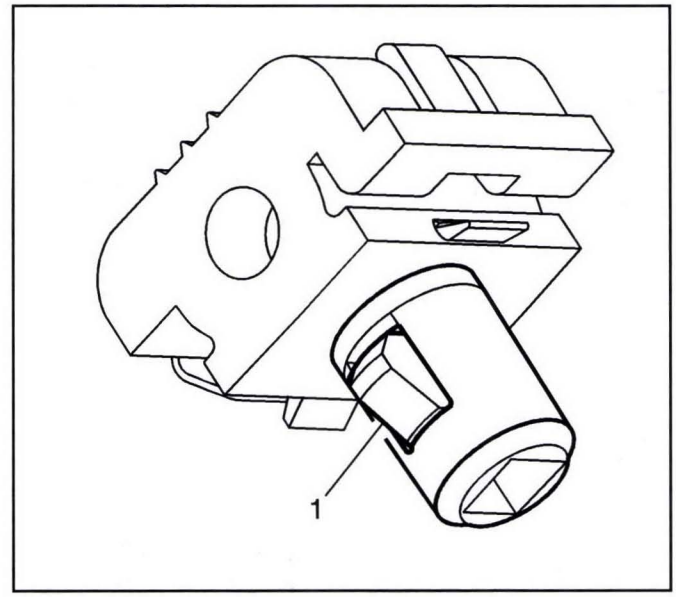
Removal Procedure



2829645

Note: It maybe necessary to remove the front or rear side door latch from some of the vehicles to access the rod clip, refer to the appropriate procedure in this sub-section.

1. Using the appropriate tool, open the outside door handle rod clip (1) on the latch.



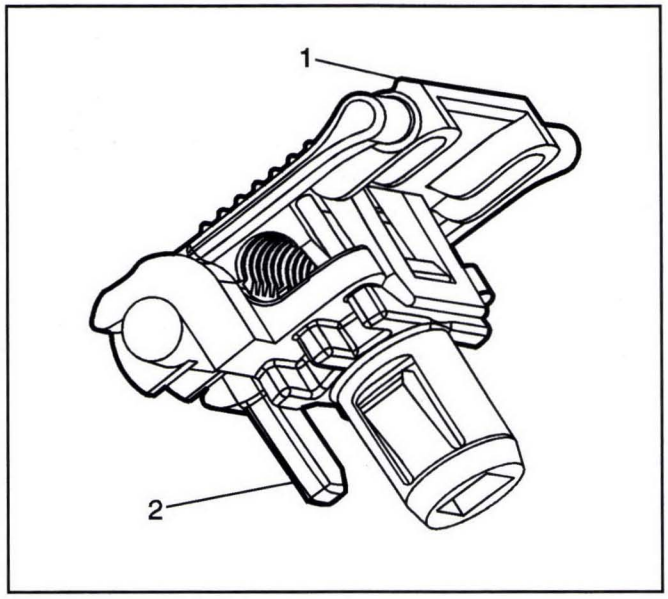
2790591

Note: The clip for the outside door handle rod is designed for one use only, a new clip Must be installed to the door latch to retain the outside handle rod.

Note: Use the appropriate tool to push in on the retaining tabs (1) located on each side of the old clip to remove.

2. Remove the old outside door handle rod clip from the door latch.

Installation Procedure



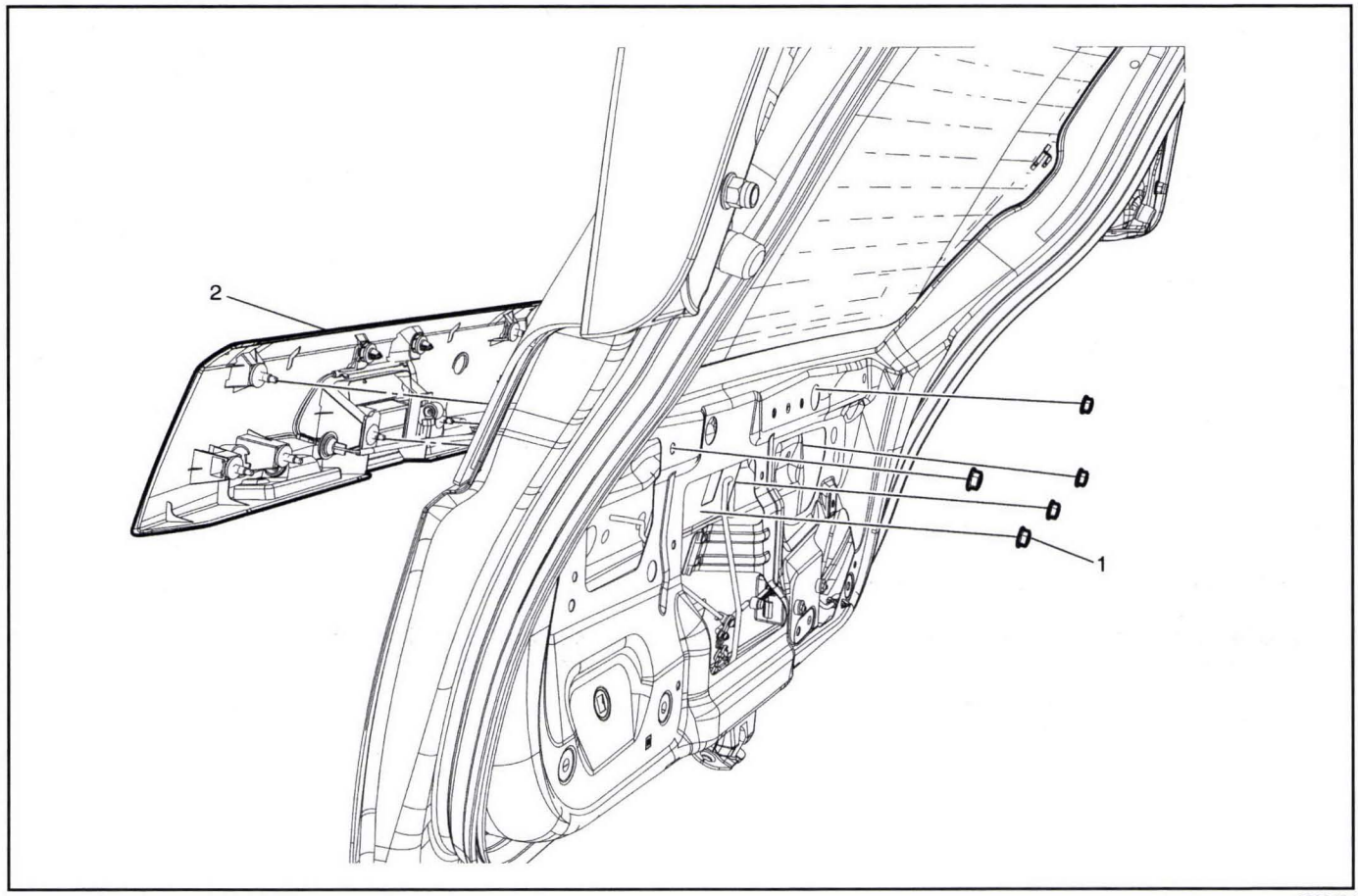
2790592

Note: When replacing the old designed outside door handle rod clip with the new designed clip (1) the anti rotation tab (2) will need to be removed.

Note: When installing the outside door handle rod to latch in order to prevent outside handle lever pre-load, the outside handle shall be fully secured to the door prior to securing integral latch clip to outside handle release rod. Push upward at the bottom the rod clip.

1. Install the new outside door handle rod clip (1) to the latch.
2. Verify the outside door handle will release the door latch.

Liftgate Outside Handle Replacement

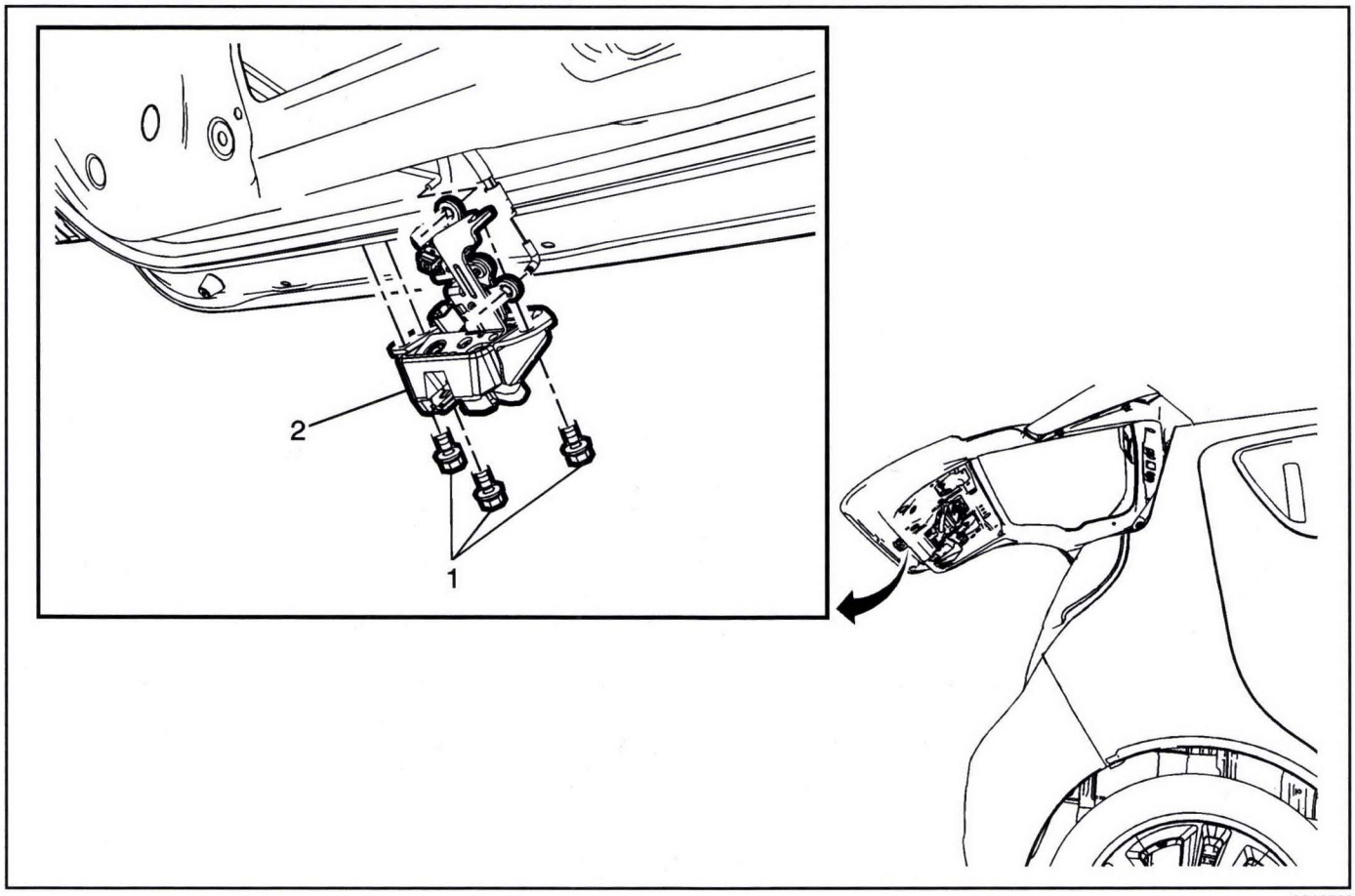


2309084

Liftgate Outside Handle Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the liftgate trim finish panel. Refer to *Liftgate Trim Finish Panel Replacement on page 2-70*. 2. Remove the liftgate lock cylinder. Refer to *Liftgate Lock Cylinder Replacement on page 4-259*.	
1	Liftgate Outside Handle Nut (Qty: 5) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 5 N•m (44 lb in)
2	Liftgate Outside Handle **Procedure** Disconnect the license plate lamp electrical connector. Refer to *Rear License Plate Lamp Replacement on page 4-191*.

Liftgate Latch Replacement



2916702

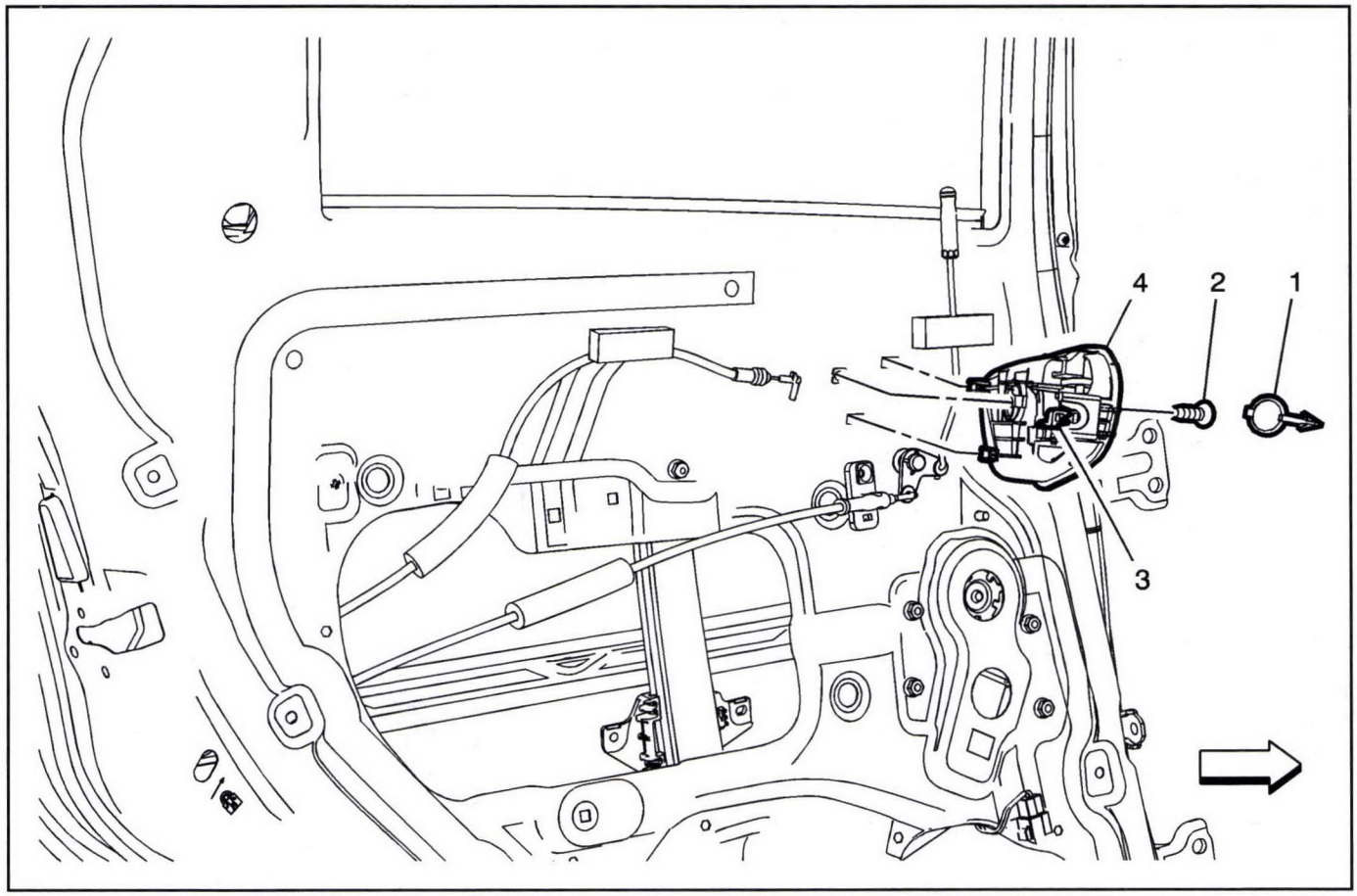
Liftgate Latch Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the liftgate trim panel. Refer to *Liftgate Trim Finish Panel Replacement on page 2-70*. 2. Remove the liftgate lock cylinder rod. 3. Remove the liftgate outside handle rod.	

Liftgate Latch Replacement (cont'd)

Callout	Component Name
1	Liftgate Latch Bolt (Qty: 3) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 12 N•m (106 lb in)
2	Liftgate Latch Assembly

Rear Side Door Inside Handle Replacement



2921323

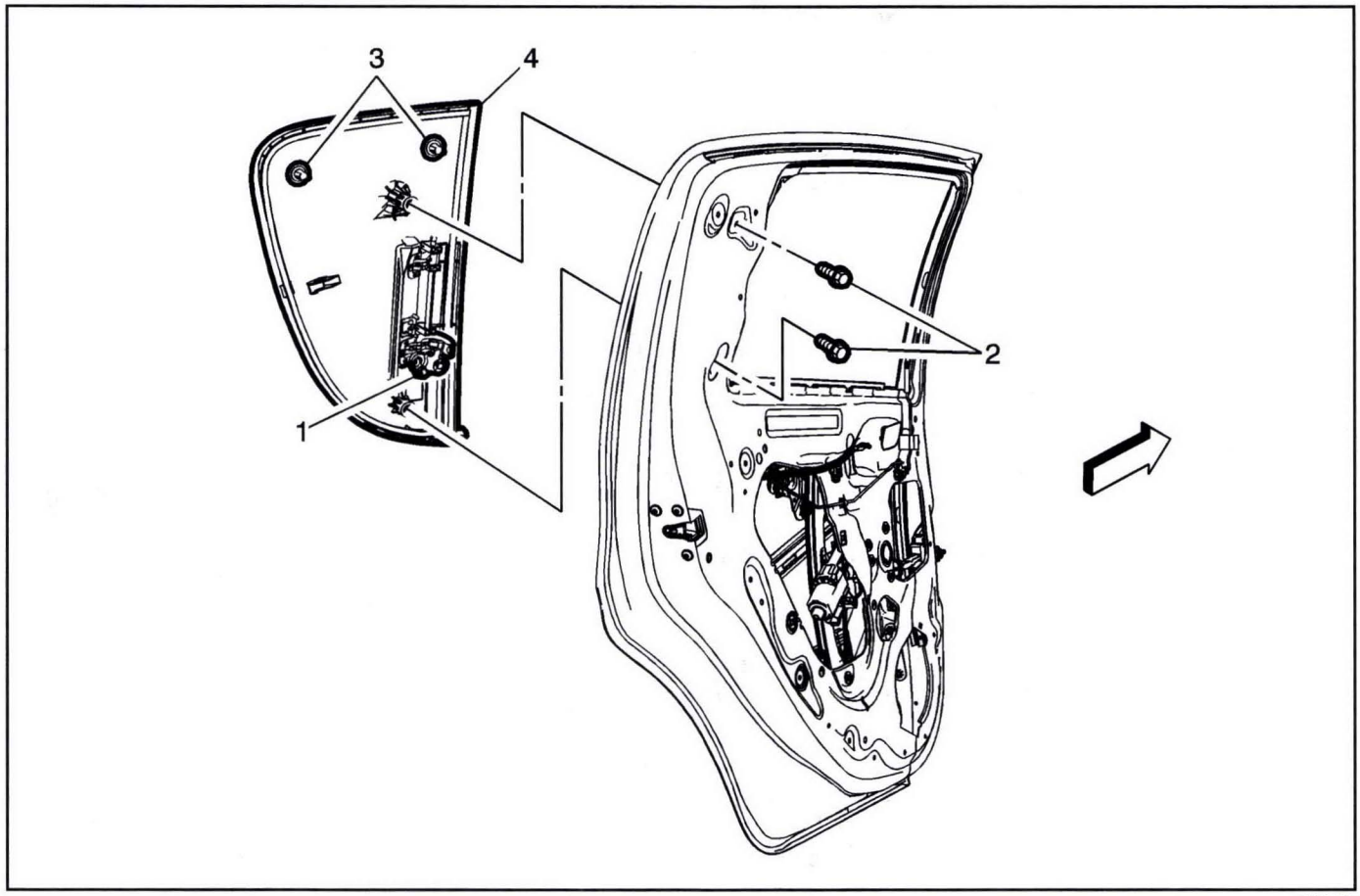
Rear Side Door Inside Handle Replacement

Callout	Component Name
Preliminary Procedure Remove the rear side door trim. Refer to *Rear Side Door Trim Replacement on page 2-68*.	
1	Rear Side Door Inside Handle Cap
2	Rear Side Door Inside Handle Screw **Caution:** Refer to *Fastener Caution on page 0-8*. **Procedure** 1. Place the window in the full up position. 2. Remove the water deflector. 3. Release the rear side door inside handle cable from the clip. **Tighten** 2 N•m (18 lb in)
3	Rear Side Door Inside Handle Cable Clip **Note:** Release the rear side door inside handle cable clip from the handle to remove.

Rear Side Door Inside Handle Replacement (cont'd)

Callout	Component Name
4	Rear Side Door Inside Handle **Procedure** Transfer components as necessary. **Note:** Inspect the door lock system for proper operation before installing the door trim.

Rear Side Door Outside Handle Replacement



2425047

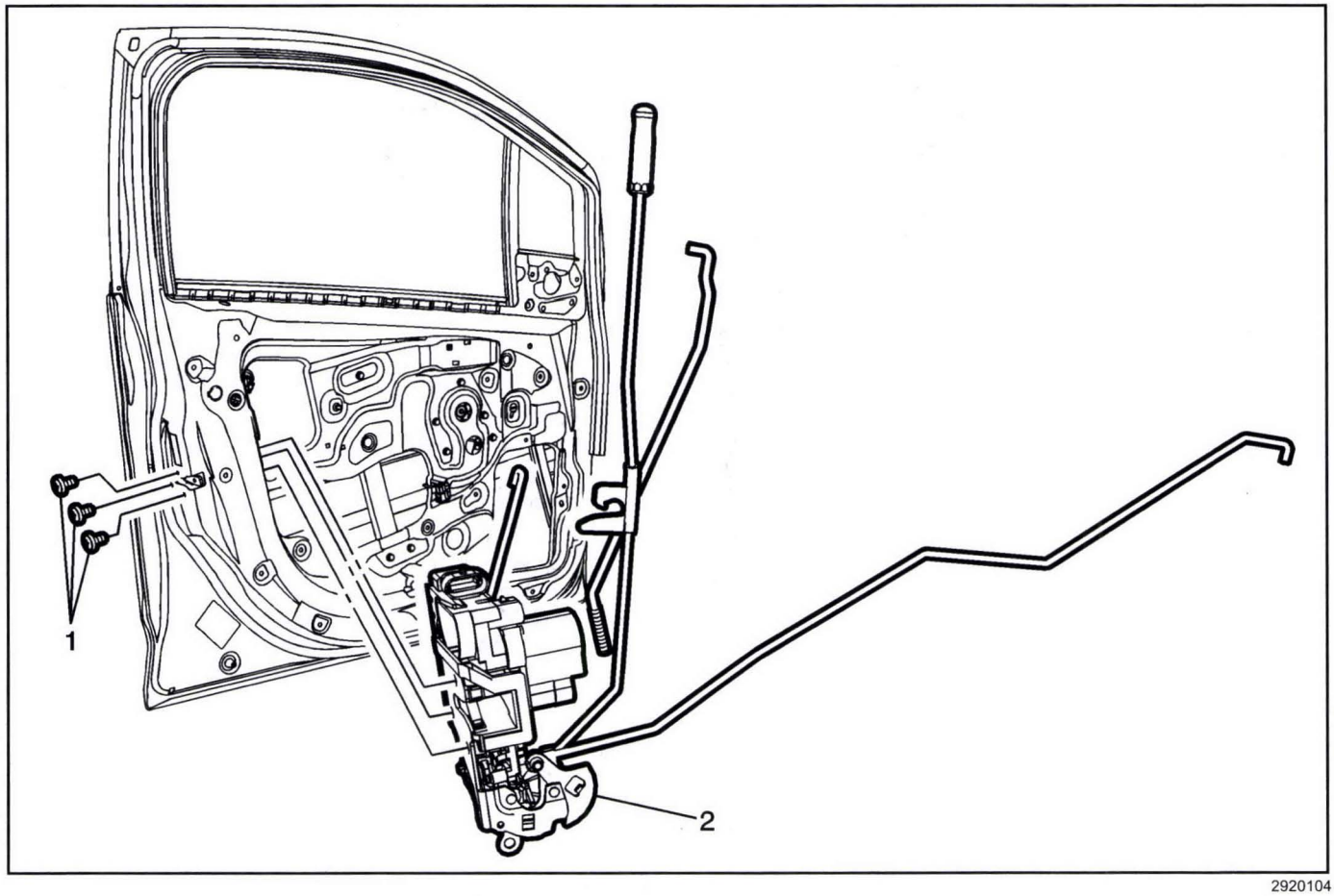
Rear Side Door Outside Handle Replacement

Callout	Component Name
Preliminary Procedures Remove the rear side door trim. Refer to *Rear Side Door Trim Replacement on page 2-68*.	
1	Rear Side Door Outside Handle Rod Clip **Procedure** 1. Place the window in the full up position. 2. Remove the water deflector. 3. Remove the outside door handle rod from the clip, Do not remove the rod from the door lock.
2	Rear Side Door Outside Handle Screws (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 9 N•m (80 lb in)
3	Rear Side Door Outside Handle Push-In Retainers (Qty: 2) **Tip:** If the retainers are broken when removing they Must be replaced.

Rear Side Door Outside Handle Replacement (cont'd)

Callout	Component Name
4	Rear Side Door Outside Handle **Procedure** In order to prevent outside handle lever pre-load, lock, outside handle shall be fully secured to the door prior to securing integral lock clip to outside handle rod. Integral lock clip shall be in the full up position while securing to outside handle rod. Refer to *Rear Side Door Outside Handle Rod Adjustment on page 4-276*. **Note:** Inspect the door lock system for proper operation before installing the door trim.

Front Side Door Lock Replacement



2920104

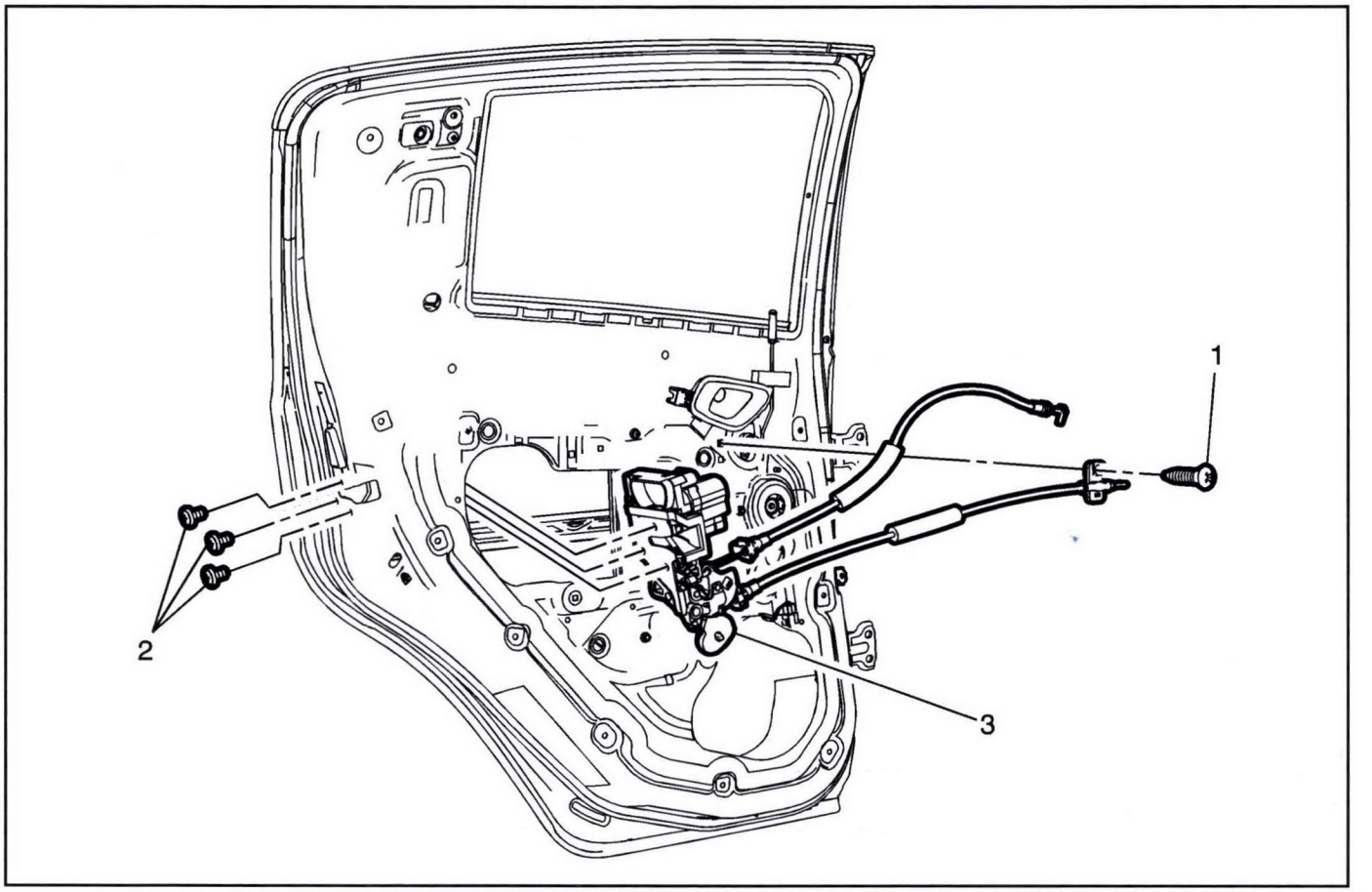
Front Side Door Lock Replacement

Callout	Component Name
Preliminary Procedure 1. Remove the front side door trim . Refer to *Front Side Door Trim Replacement on page 2-53*. 2. Remove the front side door inside handle. Refer to *Front Side Door Inside Handle Replacement on page 4-260*.	
1	Front Side Door Lock Screw (Qty: 3) **Caution:** Refer to *Fastener Caution on page 0-8*. **Procedure** 1. Remove the water deflector. 2. Disconnect the door lock electrical connector from the lock. 3. Disconnect the front side door outside handle rod from the handle. **Tighten** 8.5 N•m (75 lb in)

Front Side Door Lock Replacement (cont'd)

Callout	Component Name
2	Front Side Door Lock **Procedure** 1. Transfer components as necessary to the new lock. 2. In order to prevent outside handle lever pre-load, lock, outside handle, handle bracket and cover/cap shall be fully secured to the door prior to securing integral lock clip to outside handle rod. Integral lock clip shall be in the full up position while securing to outside handle rod. Refer to *Front Side Door Outside Handle Rod Adjustment on page 4-272*. **Note:** Inspect the door lock system for proper operation before installing the door trim.

Rear Side Door Lock Replacement



2921328

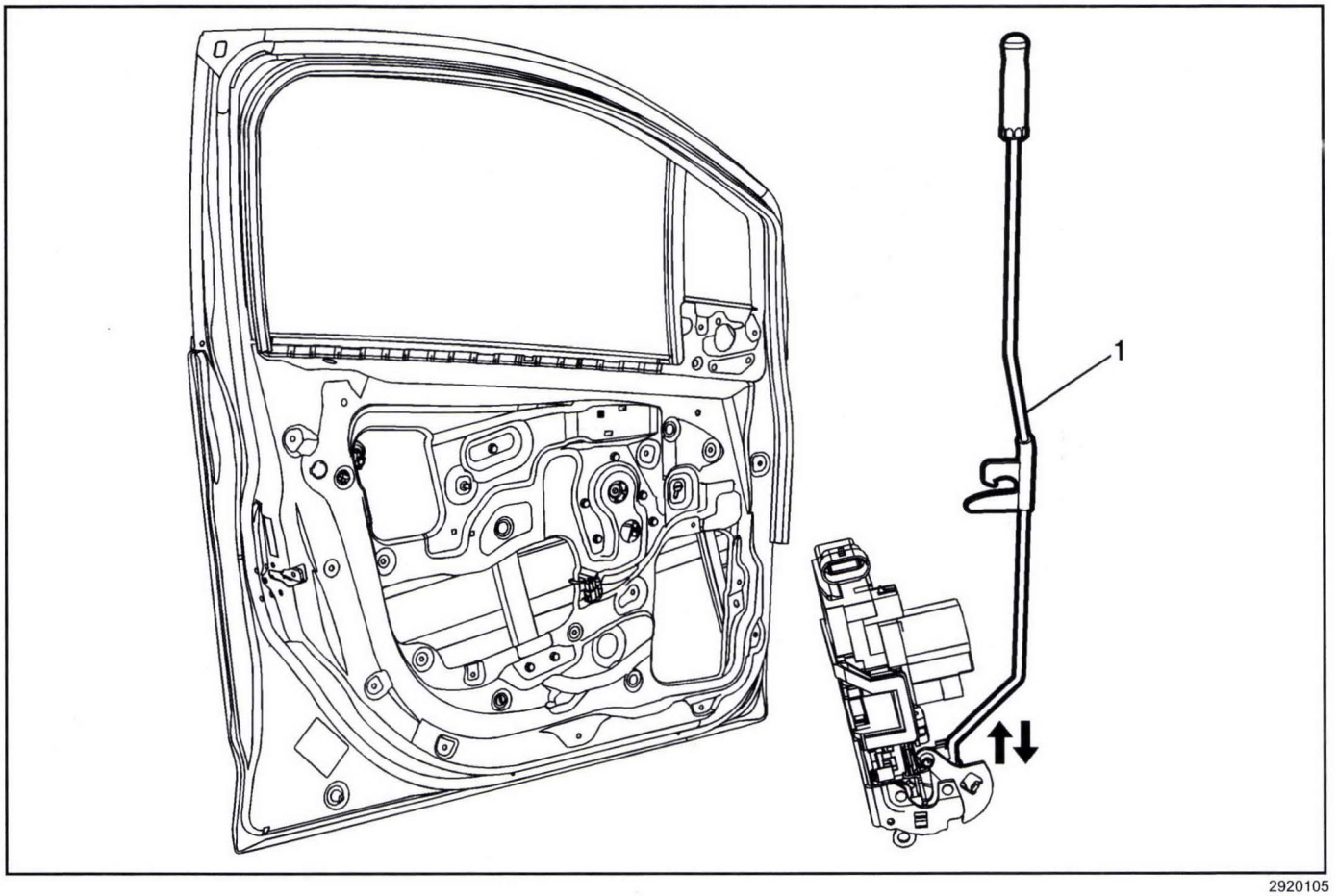
Rear Side Door Lock Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the rear side door trim. Refer to *Rear Side Door Trim Replacement on page 2-68*. 2. Remove the rear side door water deflector. 3. Disconnect the rear side door outside handle rod, inside handle rod and lock rod.	
1	Rear Side Door Lock Cable Screw
2	Rear Side Door Lock Screw (Qty: 3) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 8.5 N•m (75 lb in)

Rear Side Door Lock Replacement (cont'd)

Callout	Component Name
3	Rear Side Door Lock Assembly 1. Disconnect the door lock electrical connector. 2. Transfer components as necessary. **Note:** Inspect the door lock system for proper operation before installing the door trim.

Front Side Door Locking Rod Replacement

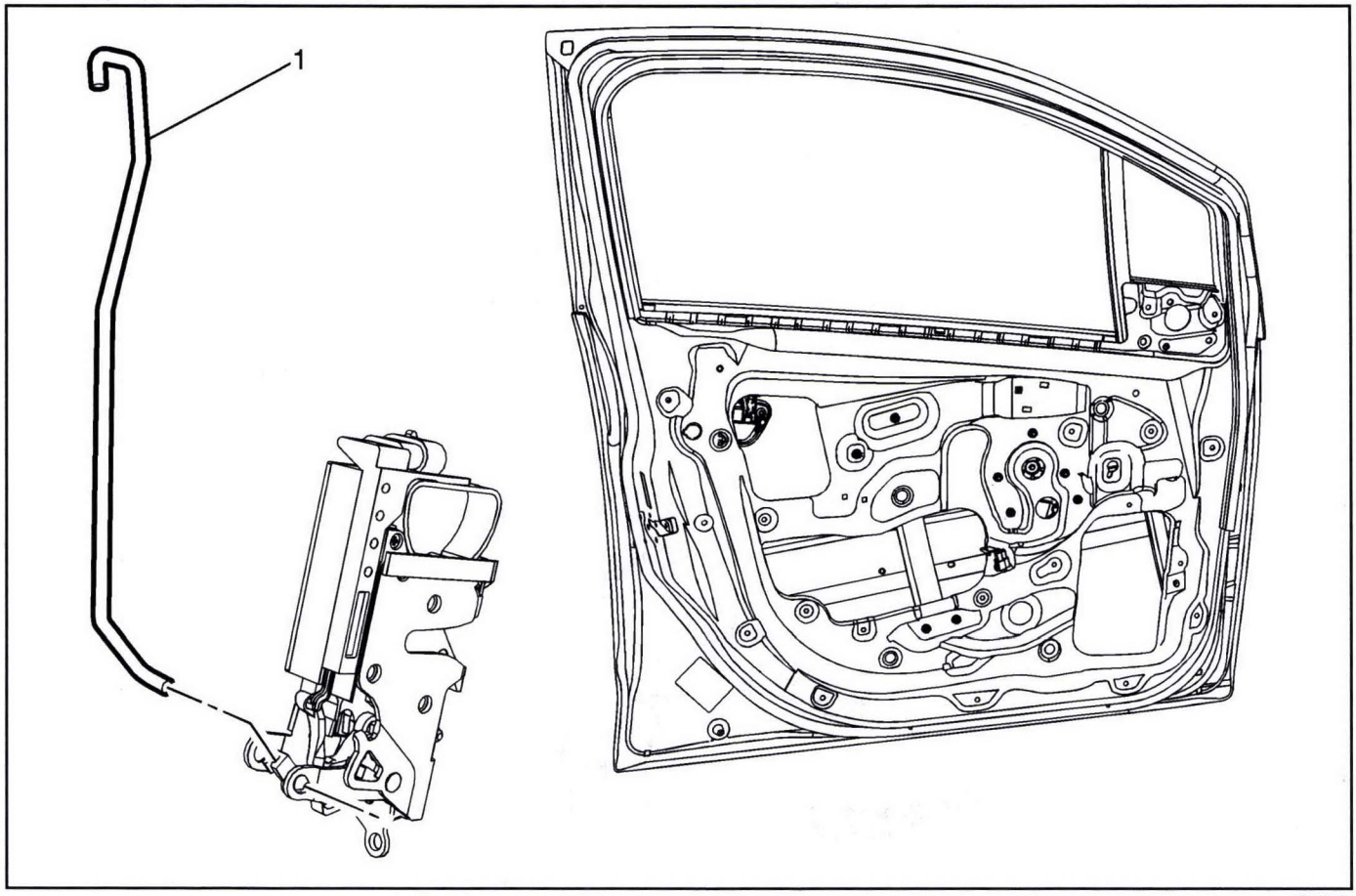


2920105

Front Side Door Locking Rod Replacement

Callout	Component Name
Preliminary Procedure Remove the front side door lock. Refer to *Front Side Door Lock Replacement on page 4-268*.	
1	Front Side Door Lock Rod **Procedure** Transfer the lock rod button. **Note:** Inspect the door lock system for proper operation before installing the door trim.

Front Side Door Lock Cylinder Rod Replacement

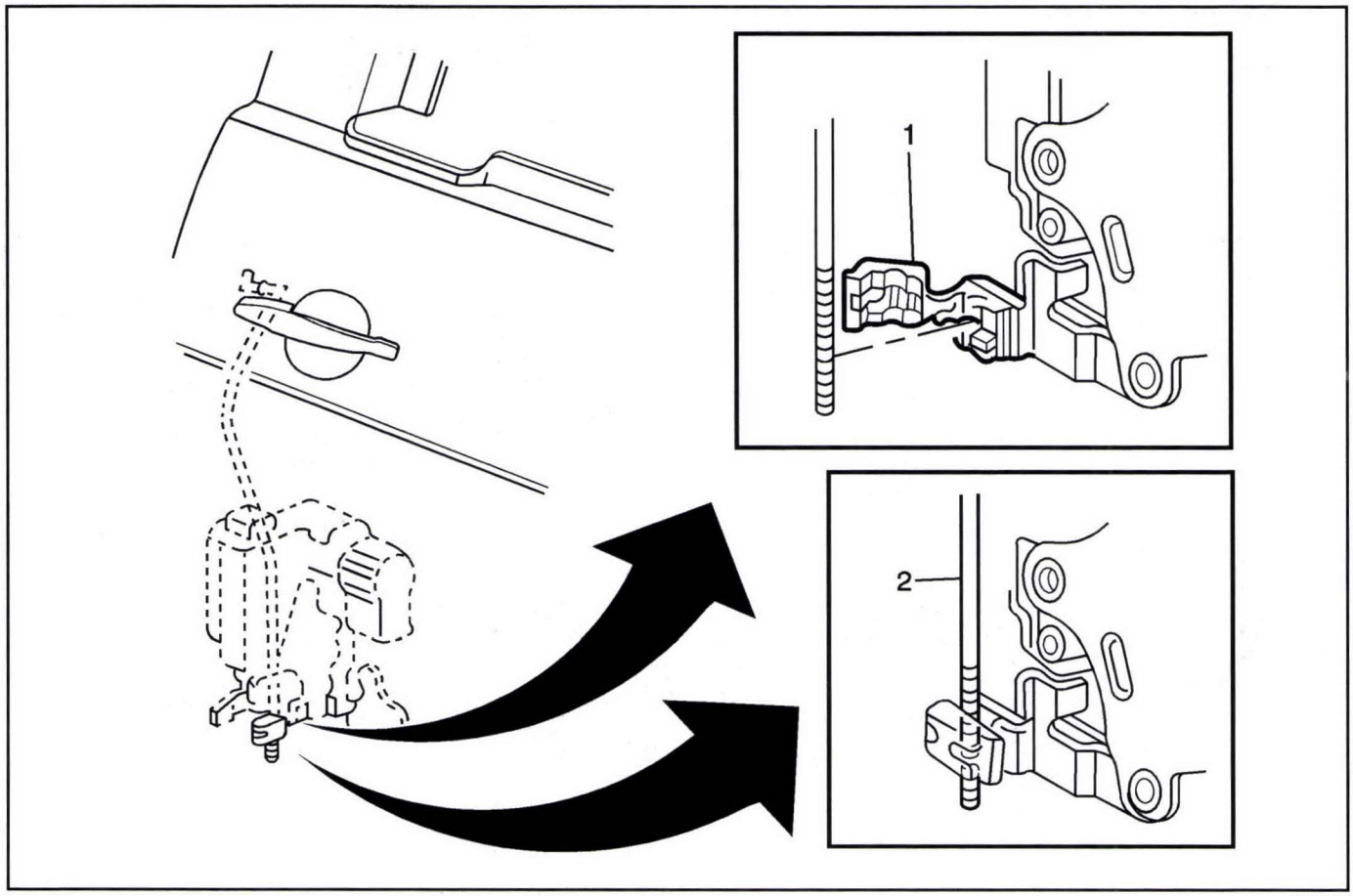


2920101

Front Side Door Lock Cylinder Rod Replacement

Callout	Component Name
Preliminary Procedure Remove the front side door lock. Refer to *Front Side Door Lock Replacement on page 4-268*.	
1	Front Side Door Lock Cylinder Rod **Procedure** In order to prevent outside handle lever pre-load, lock, outside handle, handle bracket and cover/cap shall be fully secured to the door prior to securing integral lock clip to outside handle rod. Integral lock clip shall be in the full up position while securing to outside handle rod. Refer to *Front Side Door Outside Handle Rod Adjustment on page 4-272*. **Note:** Inspect the door lock system for proper operation before installing the door trim.

Front Side Door Outside Handle Rod Adjustment



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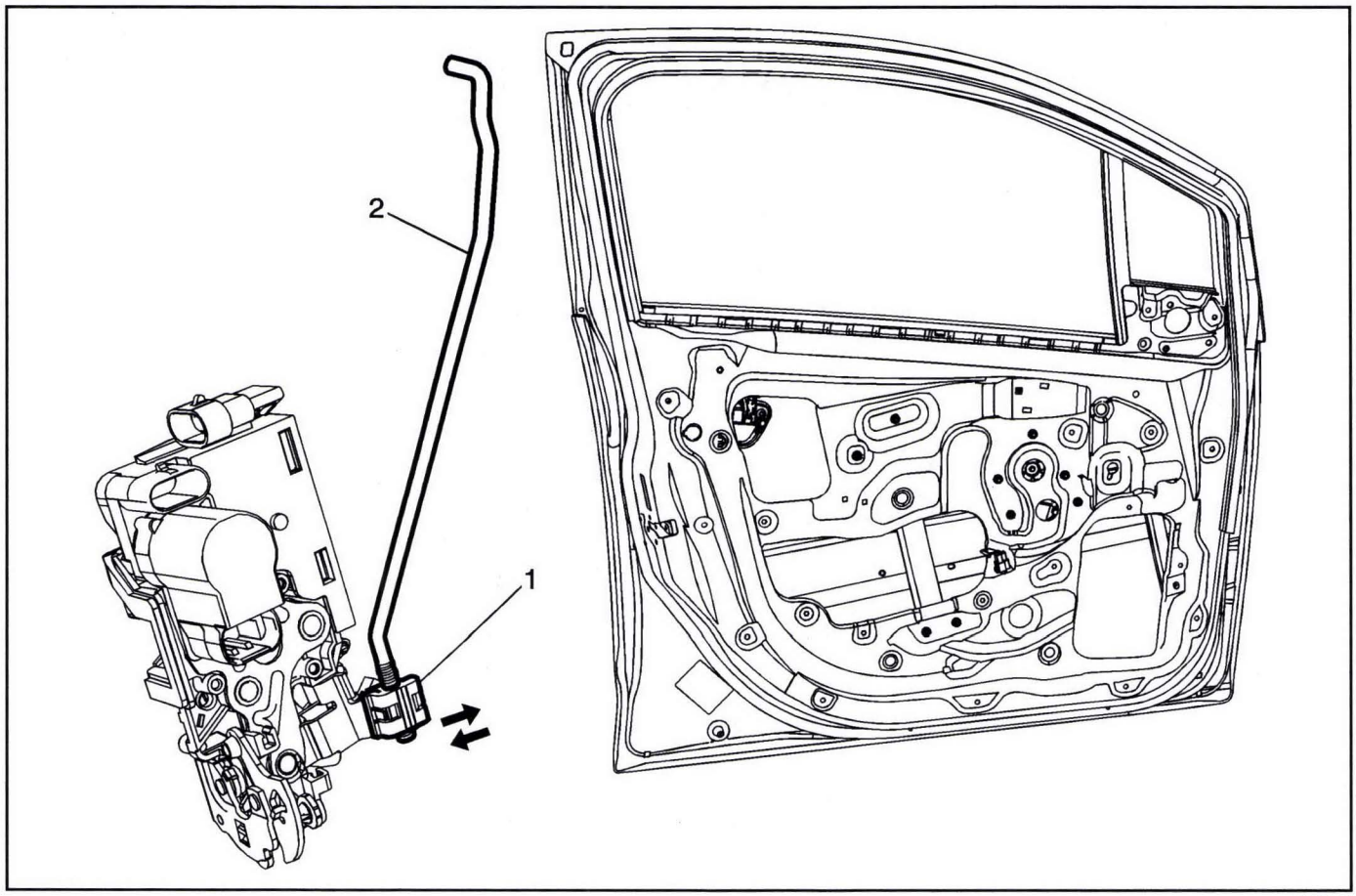
Front Side Door Outside Handle Rod Adjustment

Callout	Component Name
Preliminary Procedures Remove the front side door trim. Refer to *Front Side Door Trim Replacement on page 2-53*.	
1	Front Side Door Outside Handle Rod Clip **Procedure** 1. Remove the water deflector. 2. When replacing the rod, the clip needs to be replaced. Refer to *Front and Rear Side Door Outside Handle Rod Clip Replacement on page 4-263*
2	Front Side Door Outside Handle Rod **Procedure** 1. Use a flat-head tool to open the lower clip from the threaded rod connecting the lock to the outside handle. 2. Position the rear side door outside handle rod in the clip in order to eliminate any free play in the outside door handle. 3. Adjust the travel of the handle by removing the threaded rod from the clip. 4. Install the clip cover closed over the threaded front side door outside handle rod. **Note:** Inspect the door locking system for proper operation before installing the door trim.

Front Side Door Outside Handle Rod Replacement

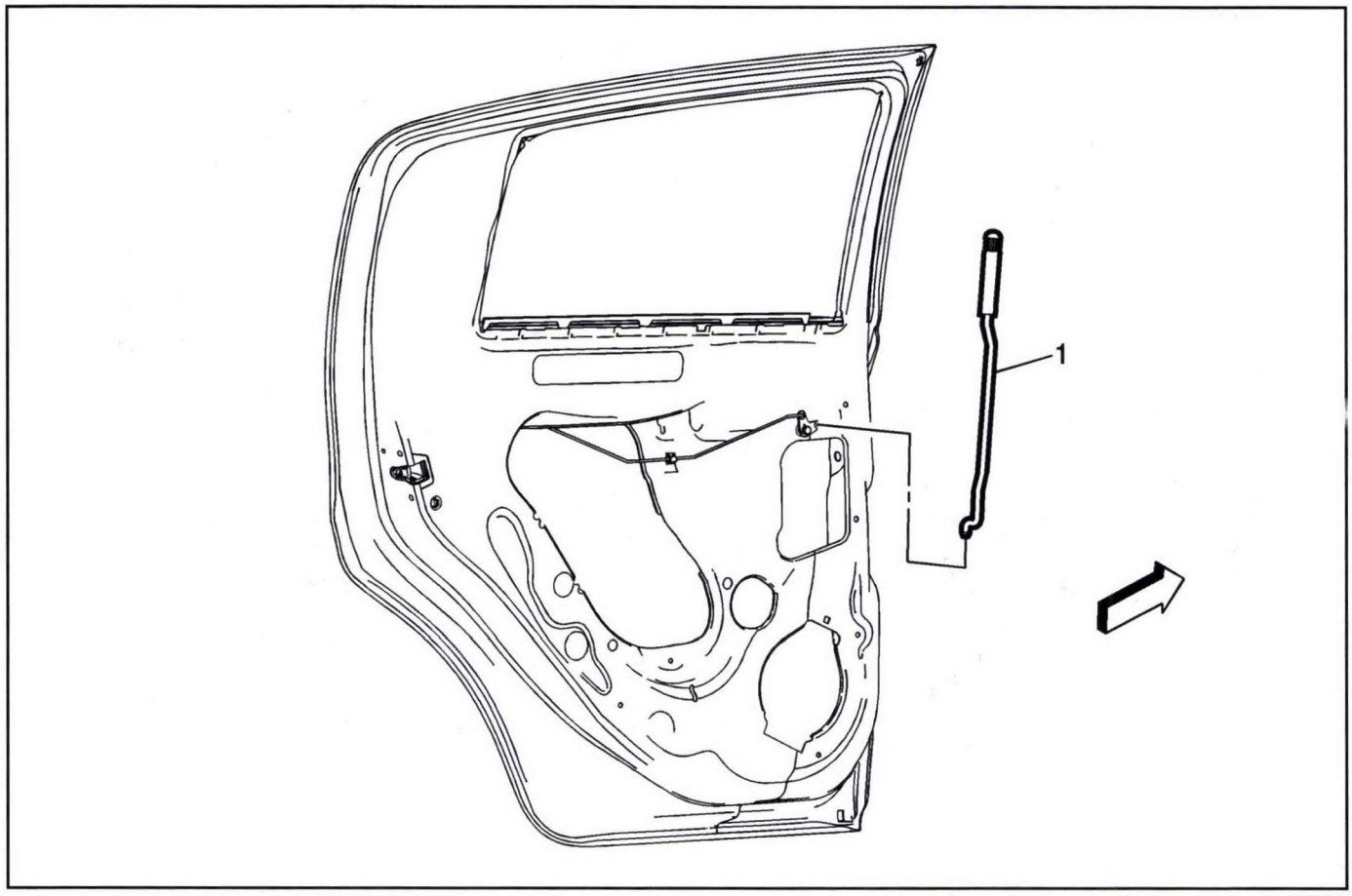


2920106

Front Side Door Outside Handle Rod Replacement

Callout	Component Name
Preliminary Procedure Remove the front side door lock. Refer to *Front Side Door Lock Replacement on page 4-268*.	
1	Front Side Door Outside Handle Rod Clip **Procedure** Replace the outside handle rod clip. Refer to *Front and Rear Side Door Outside Handle Rod Clip Replacement on page 4-263*.
2	Front Side Door Outside Handle Rod **Procedure** In order to prevent outside handle lever pre-load, lock, outside handle, handle bracket and cover/cap shall be fully secured to the door prior to securing integral lock clip to outside handle rod. Integral lock clip shall be in the full up position while securing to outside handle rod. Refer to *Front Side Door Outside Handle Rod Adjustment on page 4-272*. **Note:** Inspect the door lock system for proper operation before installing the door trim.

Rear Side Door Locking Rod Replacement

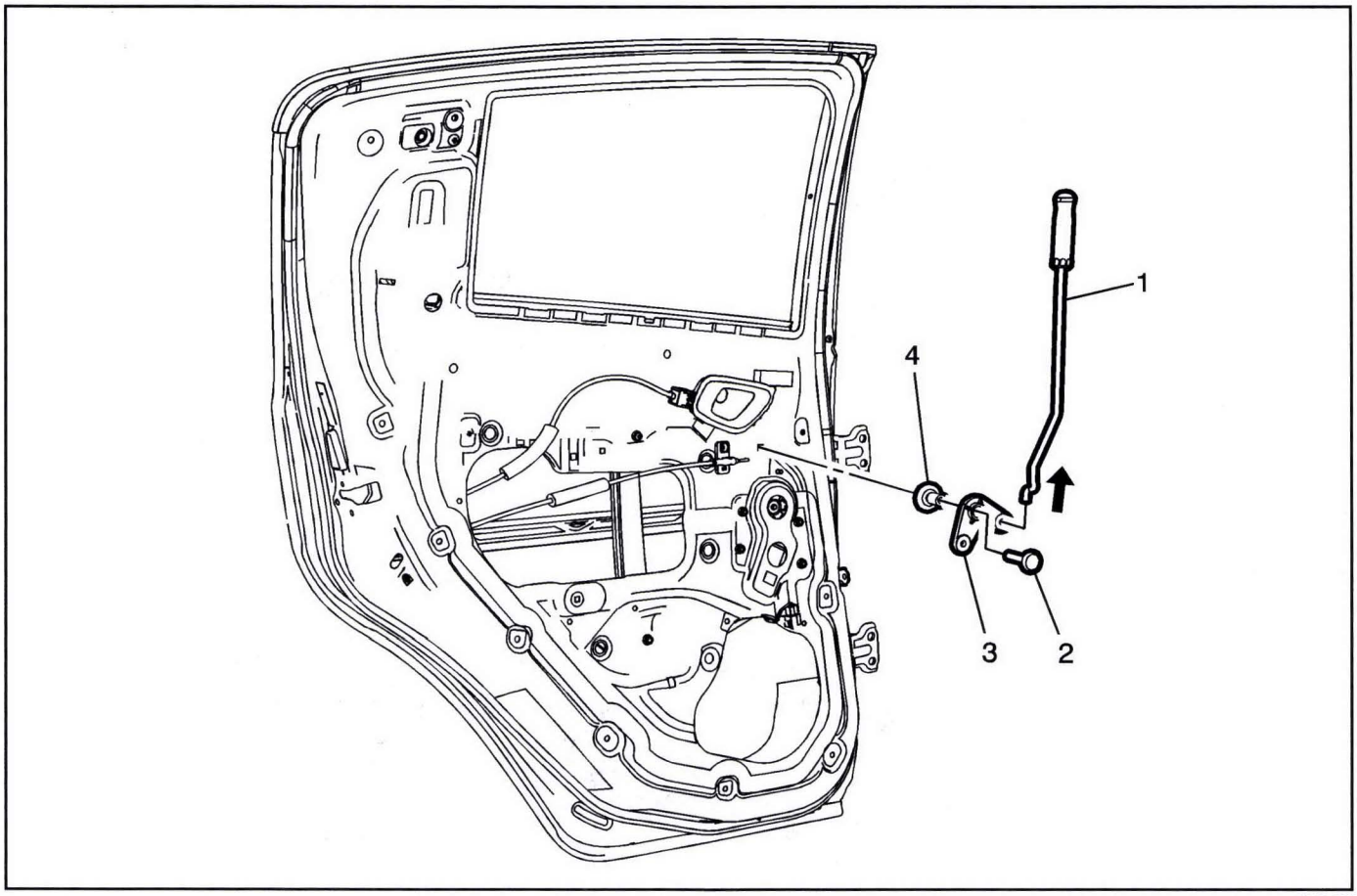


2425044

Rear Side Door Locking Rod Replacement

Callout	Component Name
Preliminary Procedure Remove the rear side door trim. Refer to *Rear Side Door Trim Replacement on page 2-68*.	
1	Rear Side Door Lock Rod **Procedure** 1. Remove the water deflector. 2. Transfer the lock rod button. **Note:** Inspect the door lock system for proper operation before installing the door trim panel.

Rear Side Door Locking Rod Bellcrank Rod Replacement

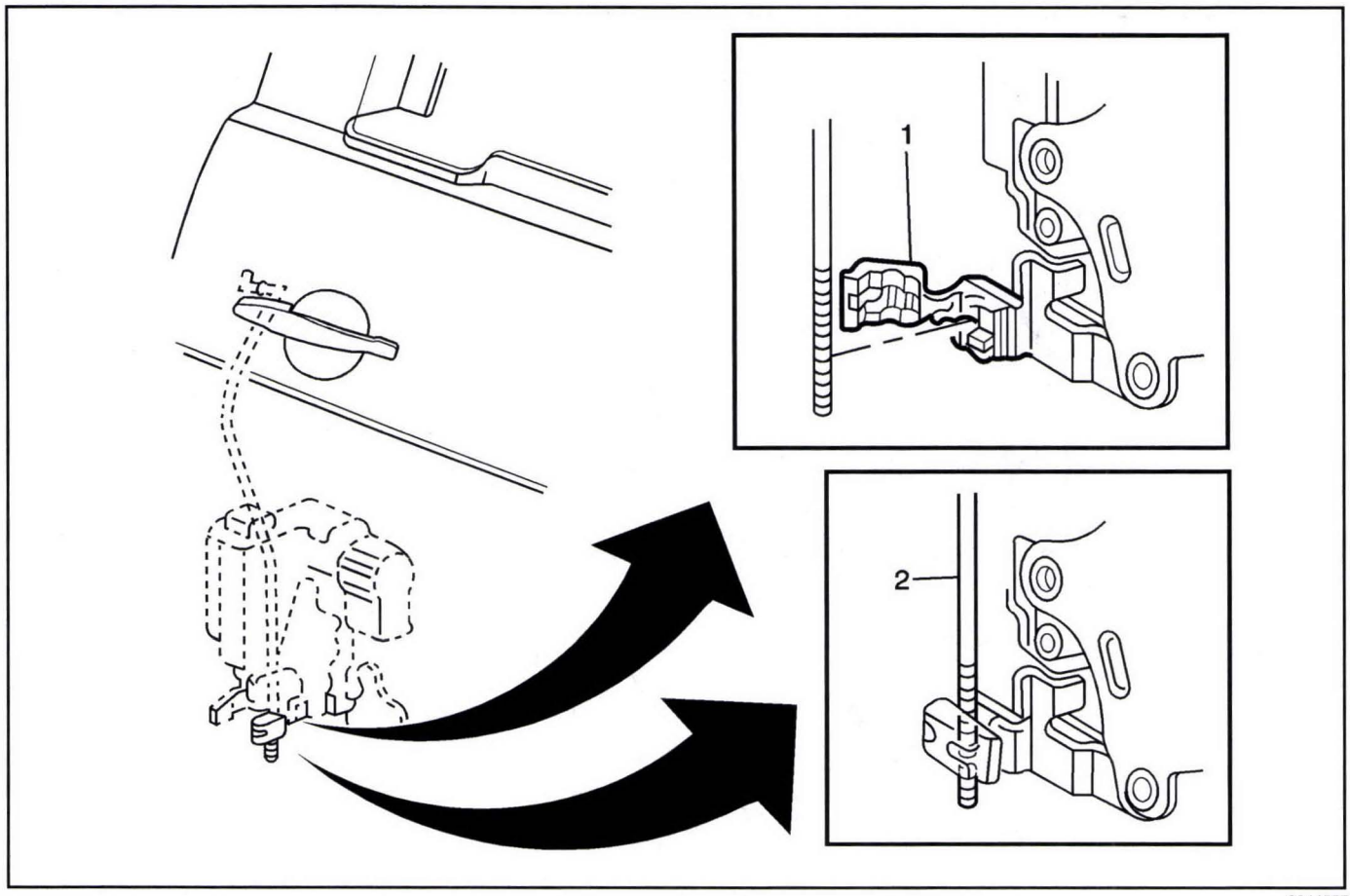


2921327

Rear Side Door Locking Rod Bellcrank Rod Replacement

Callout	Component Name
Preliminary Procedure Remove the rear side door trim. Refer to *Rear Side Door Trim Replacement on page 2-68*.	
1	Rear Side Door Locking Rod **Procedure** Remove the water deflector. **Note:** Remove the lock rod before removing the bellcrank from the door.
2	Rear Side Door Locking Rod Bellcrank Pin
3	Rear Side Door Locking Rod Bellcrank
4	Rear Side Door Locking Rod Bellcrank Retainer **Note:** Inspect the door lock system for proper operation before installing the door trim.

Rear Side Door Outside Handle Rod Adjustment



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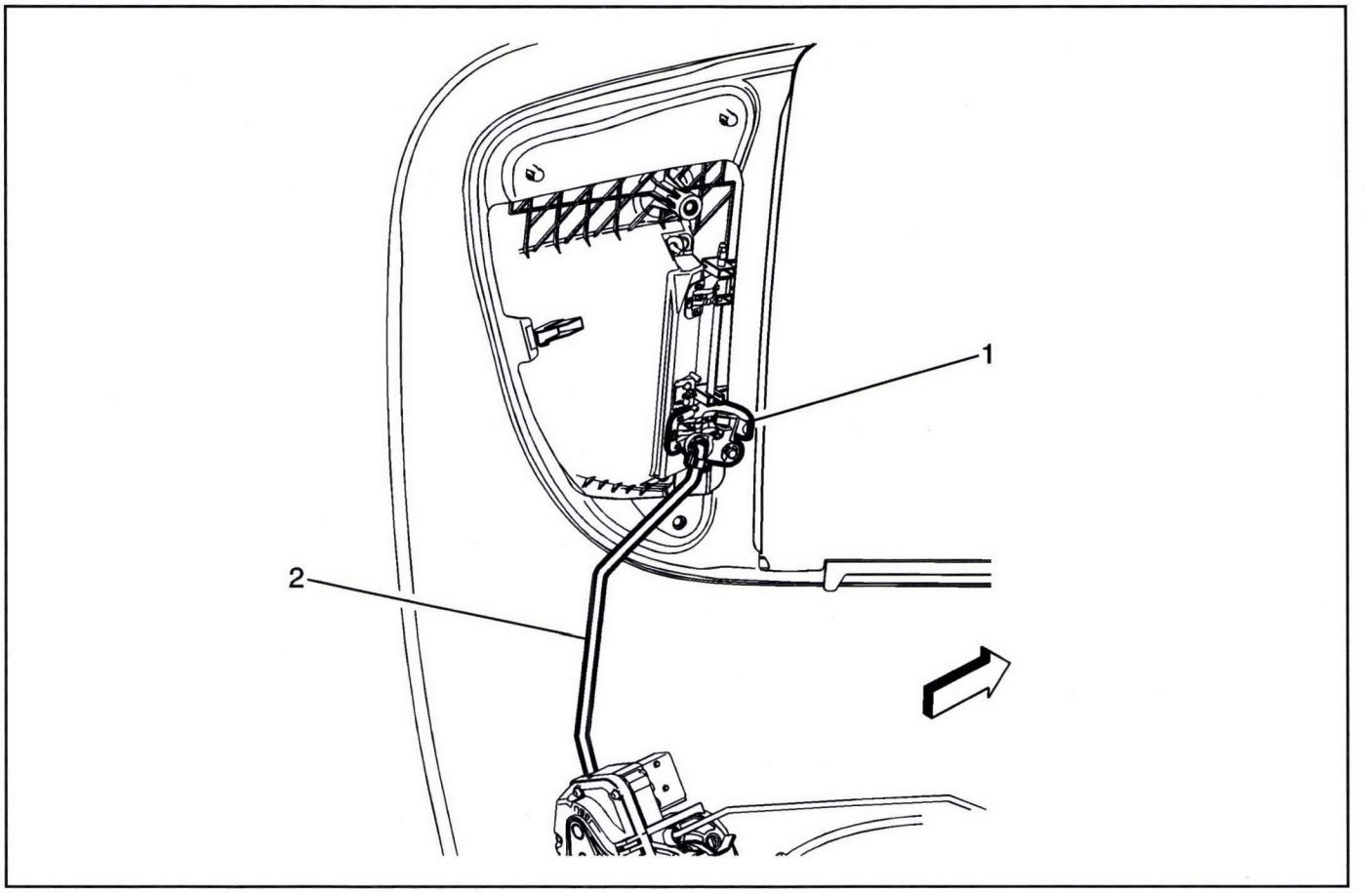
Rear Side Door Outside Handle Rod Adjustment

Callout	Component Name
Preliminary Procedures Remove the rear side door trim. Refer to *Rear Side Door Trim Replacement on page 2-68*.	
1	Rear Side Door Outside Handle Rod Clip **Procedure** 1. Remove the water deflector. 2. When replacing the rod, the clip needs to be replaced. Refer to *Front and Rear Side Door Outside Handle Rod Clip Replacement on page 4-263*
2	Rear Side Door Outside Handle Rod **Procedure** 1. Use a flat-head tool to open the lower clip from the threaded rod connecting the lock to the outside handle. 2. Position the rear side door outside handle rod in the clip in order to eliminate any free play in the outside door handle. 3. Adjust the travel of the handle by removing the threaded rod from the clip. 4. Install the clip cover closed over the threaded front side door outside handle rod. **Note:** Inspect the door locking system for proper operation before installing the door trim.

Rear Side Door Outside Handle Rod Replacement



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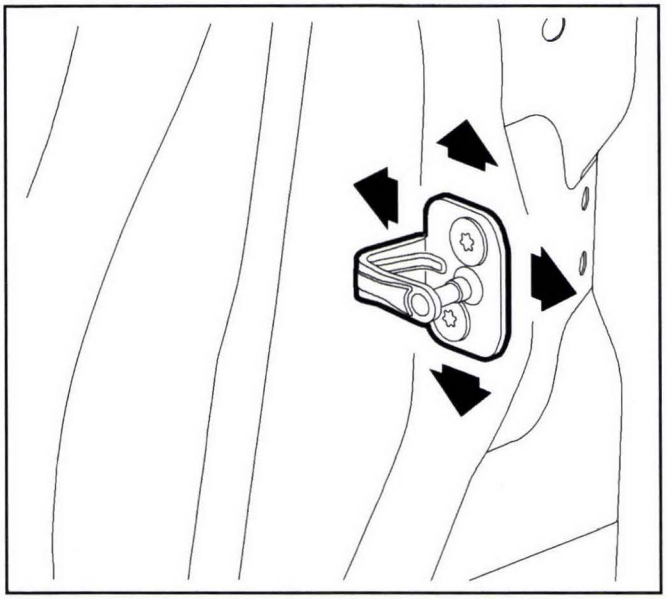
Rear Side Door Outside Handle Rod Replacement

Callout	Component Name
Preliminary Procedures Remove the rear side door trim. Refer to *Rear Side Door Trim Replacement on page 2-68*.	
1	Rear Side Door Outside Handle Rod Upper Retainer **Procedure** Remove the water deflector
2	Rear Side Door Outside Handle Rod **Procedure** 1. Use a flat-head tool to open the lower retainer from the threaded rod connecting the lock to the outside handle. 2. Position the rear side door outside handle rod in the retainer in order to eliminate any free play in the outside door handle. 3. Adjust the travel of the handle by removing the threaded rod from the retainer. 4. In order to prevent outside handle lever pre-load, lock the outside handle shall be fully secured to the door prior to securing integral lock clip to outside handle rod. Integral lock clip shall be in the full up position while securing to outside handle rod. Refer to *Rear Side Door Outside Handle Rod Adjustment on page 4-276*. 5. Inspect the door lock system for proper operation before installing the trim panel.

Front Side Door Lock Striker Adjustment

To determine if striker adjustment is required, proceed as follows:



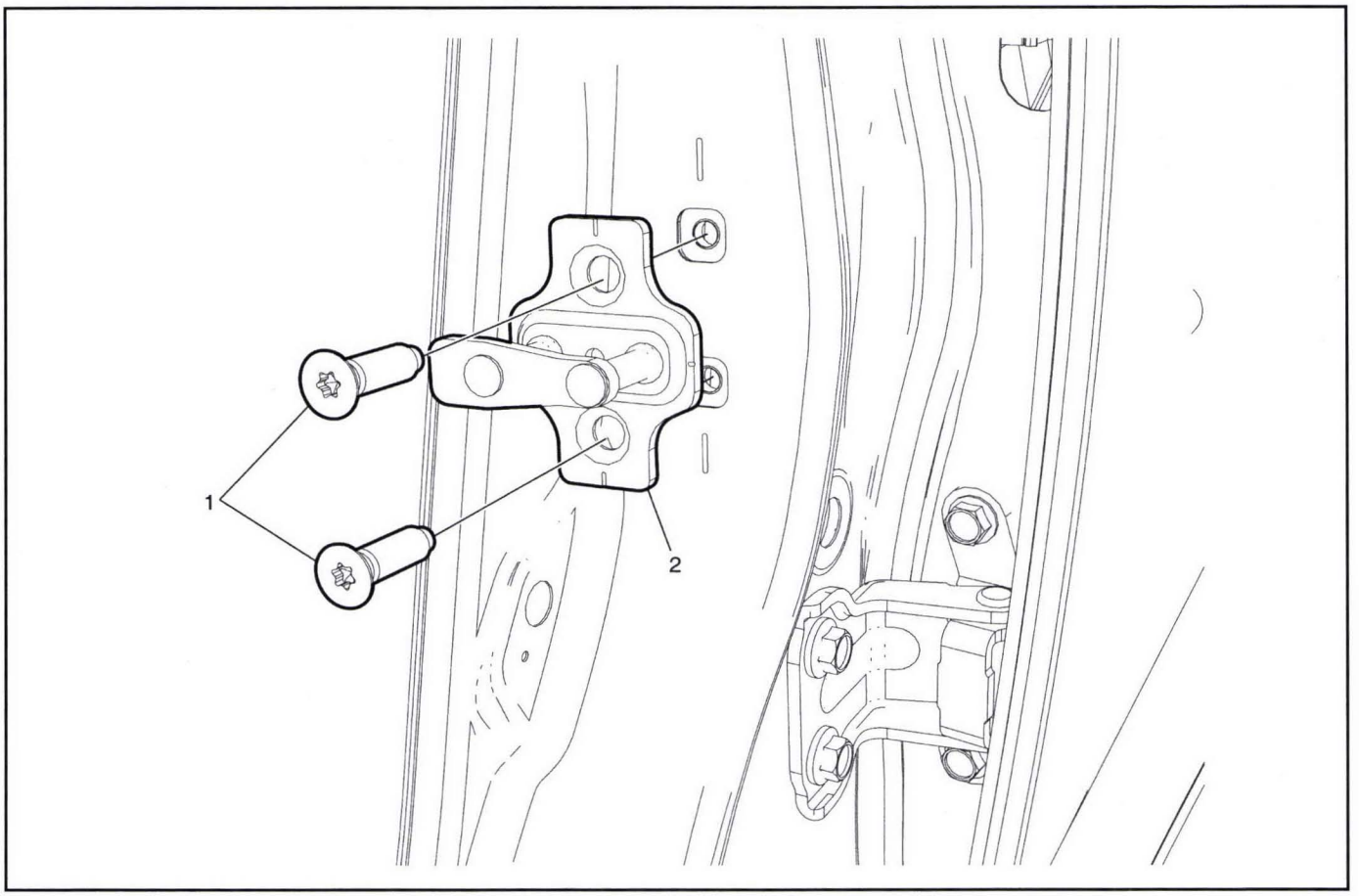
928781

1. Ensure the door is properly aligned within the door opening before proceeding with the striker adjustment.
2. Close the door onto the striker and note if the door drags on the striker causing the door to move upward or downward upon contact with the striker. Also note the closing effort to fully engage the lock.
3. Using a grease pencil, mark around the striker for reference of the original position. Loosen the striker.
4. Move the striker to eliminate drag on the striker and door lock and to achieve the proper door position within the door opening. Start with the up/down position, then position the striker to achieve proper alignment to the door opening. Set the in/out adjustment for the proper door seal engagement making sure the door closing efforts are correct.

Caution: Refer to *Fastener Caution on page 0-8*.

5. Tighten the striker bolts. Tighten the front side door striker screws to **22** N•m **(16 lb ft).**

Front Side Door Lock Striker Replacement



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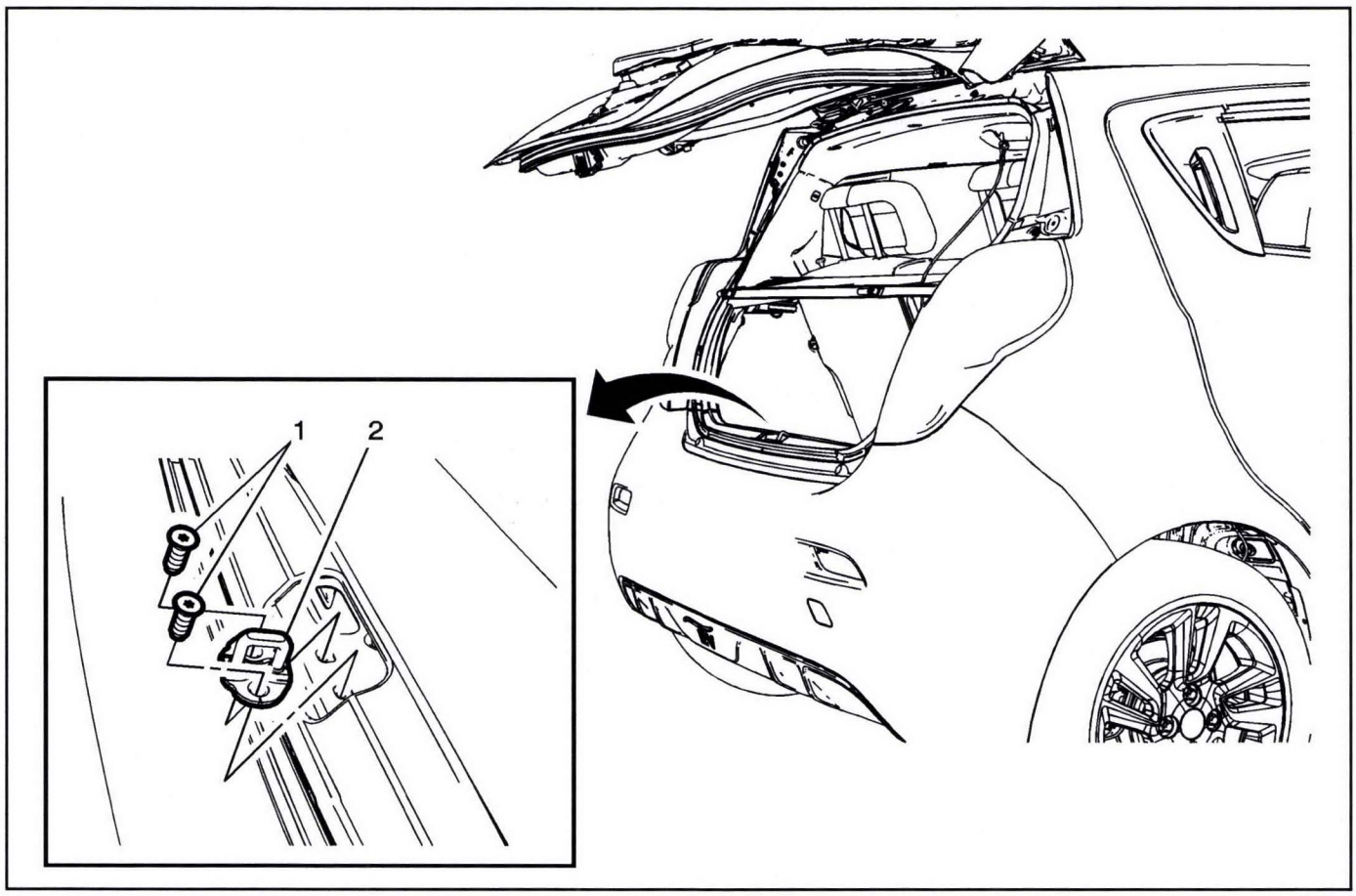
Front Side Door Lock Striker Replacement

Callout	Component Name
1	Front Side Door Lock Striker Screw (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8.* **Tighten** 30 N•m (22 lb ft)
2	Front Side Door Lock Striker **Note:** When the striker bolts have been removed, the striker anchor plate could slip down in the door pillar or quarter panel and the trim will need to be removed to gain access.

Liftgate Latch Striker Replacement



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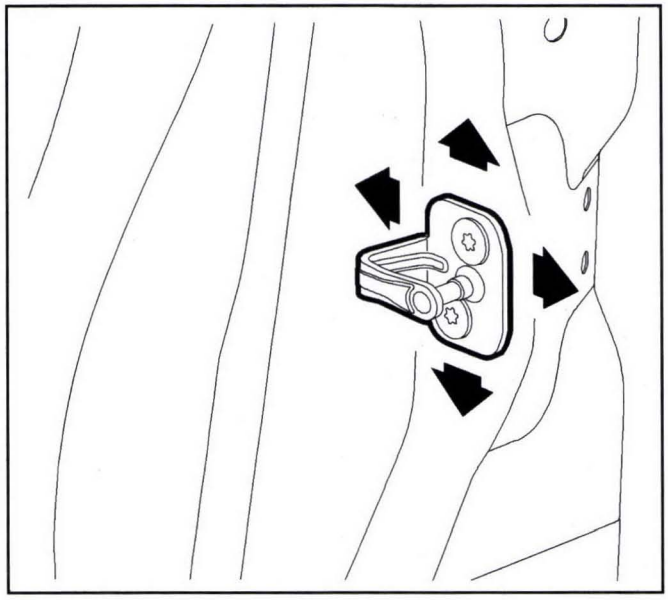
Liftgate Latch Striker Replacement

Callout	Component Name
Preliminary Procedure Open the liftgate.	
1	Liftgate Latch Striker Bolt (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8.* **Tighten** 20 N•m (15 lb ft)
2	Liftgate Latch Striker

Rear Side Door Lock Striker Adjustment

To determine if striker adjustment is required, proceed as follows:



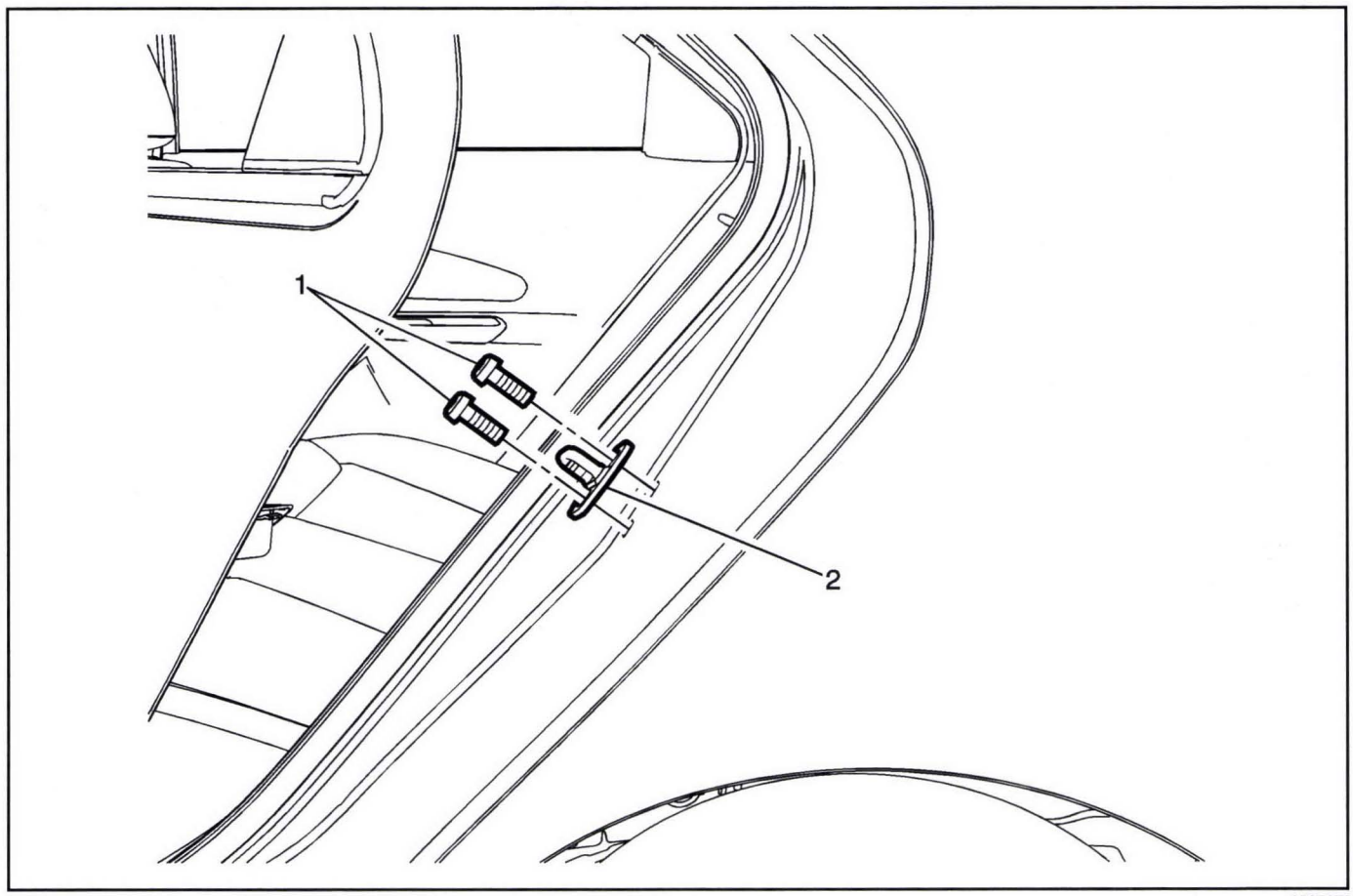
928781

1. Ensure the door is properly aligned within the door opening before proceeding with the striker adjustment.
2. Close the door onto the striker and note if the door drags on the striker causing the door to move upward or downward upon contact with the striker. Also note the closing effort to fully engage the lock.
3. Using a grease pencil, mark around the striker for reference of the original position. Loosen the striker.
4. Move the striker to eliminate drag on the striker and door lock and to achieve the proper door position within the door opening. Start with the up/down position, then position the striker to achieve proper alignment to the door opening. Set the in/out adjustment for the proper door seal engagement making sure the door closing efforts are correct.

Caution: Refer to *Fastener Caution on page 0-8*.

5. Tighten the striker bolts. Tighten the rear side door striker bolts to **22 N•m (16 lb ft).**

Rear Side Door Lock Striker Replacement

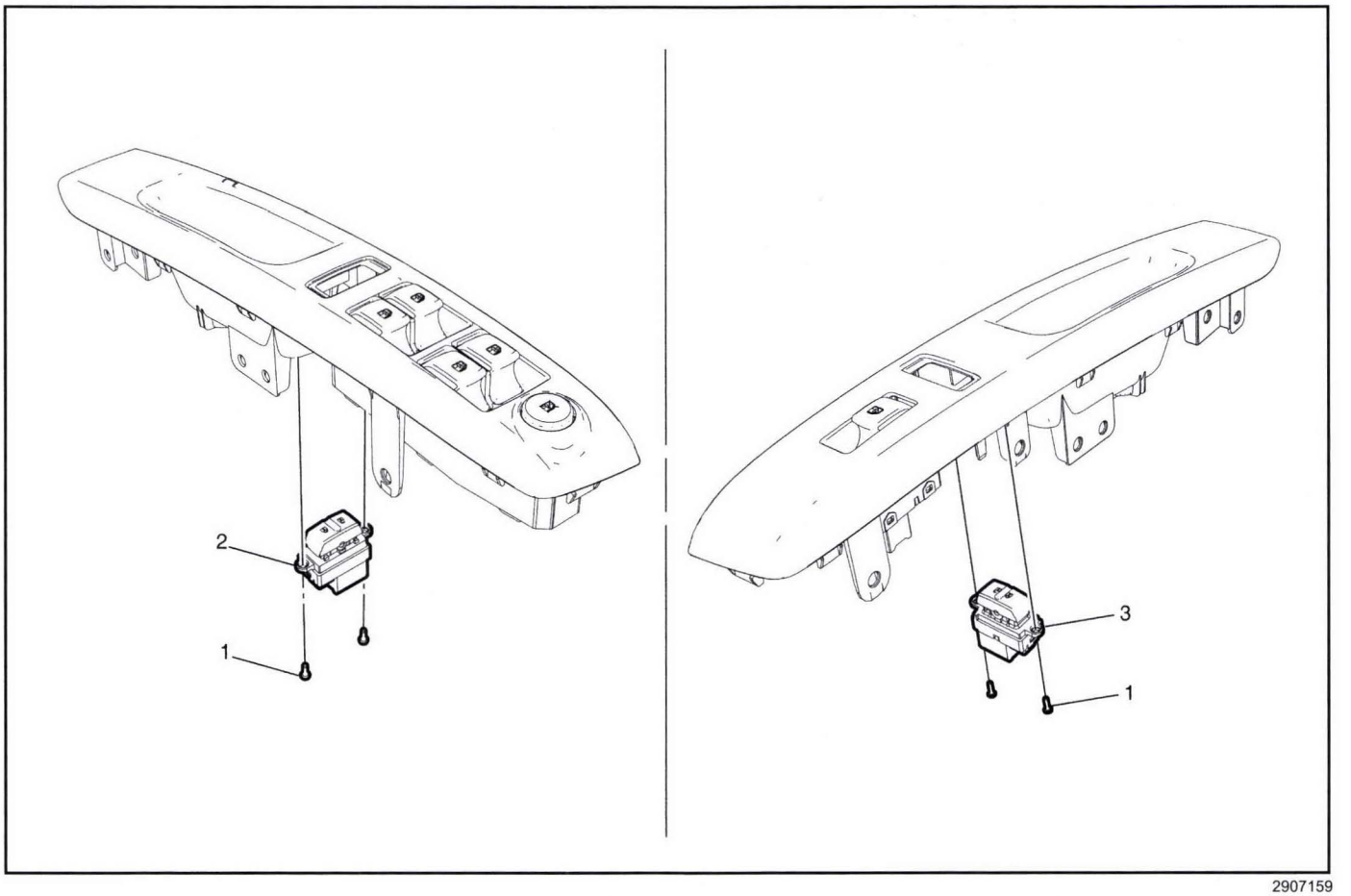


2587670

Rear Side Door Lock Striker Replacement

Callout	Component Name
1	Rear Side Door Lock Striker Screws (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 30 N•m (22 lb ft)
2	Rear Side Door lock Striker **Procedure** 1. Ensure the spacer is in place, if equipped. 2. Ensure proper alignment after installation. Refer to *Rear Side Door Lock Striker Adjustment on page 4-280*.

Door Lock Switch Replacement



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Door Lock Switch Replacement

Callout	Component Name
Preliminary Procedure Remove the front side door armrest switch mount plate from the door trim. Refer to *Front Side Door Armrest Switch Mount Plate Replacement on page 2-51*.	
1	Door Lock Switch Screw **Caution:** Refer to *Fastener Caution on page 0-8*.
2	Door Lock Switch – Driver Side
3	Door Lock Switch – Passenger Side

Description and Operation

Charge Port Door Description and Operation

Charge Port System Components

The charge port system consists of the following components:

- Charge port door position sensor
- Hybrid/EV powertrain control module 2

Charge Port Ajar Message

When the vehicle is in the Service Mode or ON, the hybrid/EV powertrain control module 2 supplies a 5V signal to the charge port door position switch through the charge port door sensor signal circuit. The charge port door position switch contains a resistor ladder interface for switch position between two resistors for sensing used by the hybrid/EV powertrain control module 2 to determine if the charge port door is in the open position or the closed position. The hybrid/EV powertrain control module 2 sends a serial data message to the driver information center in the instrument panel cluster to display the Charge Door Open message.

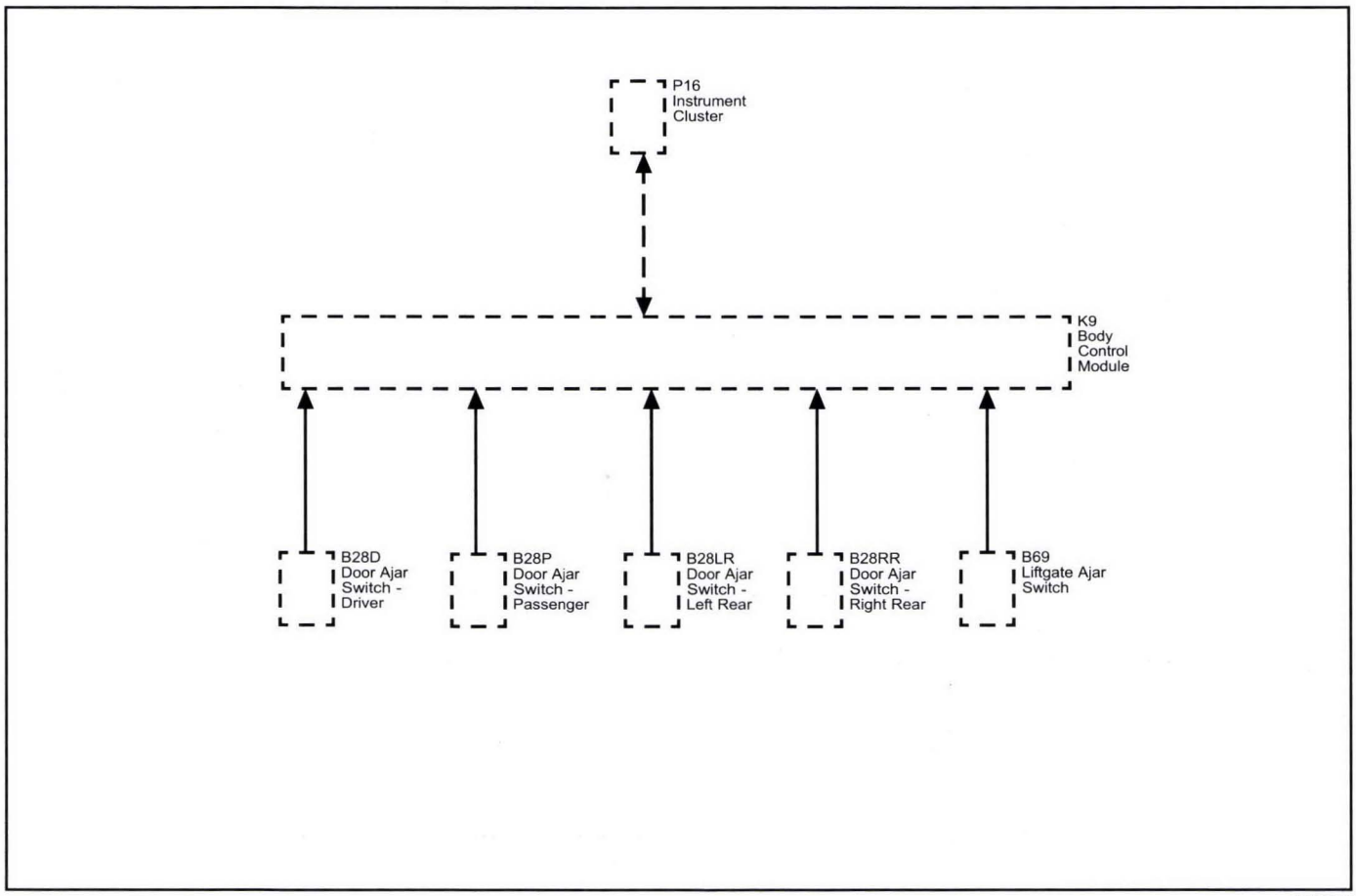
Door Ajar Indicator Description and Operation

Door Ajar Indicator System Components

The door ajar indicator system consists of the following components:

- The body control module (BCM)
- The instrument cluster
- The driver door ajar switch
- The passenger door ajar switch
- The left rear door ajar switch
- The right rear door ajar switch
- The liftgate ajar switch

Door Ajar Indicator Block Diagram



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Driver and Passenger Door Ajar Operation

The body control module (BCM) provides a 12V signal to each door ajar switch and the liftgate ajar switch via the ajar switch signal circuit. The door ajar switches are normally open when the door is fully closed. When a door or liftgate is opened, the ajar switch contacts close providing a path to ground. The driver information center displays door ajar icon when the BCM detects that one of the doors or liftgate are open. The instrument cluster receives a serial data message from the BCM indicating the door ajar status.

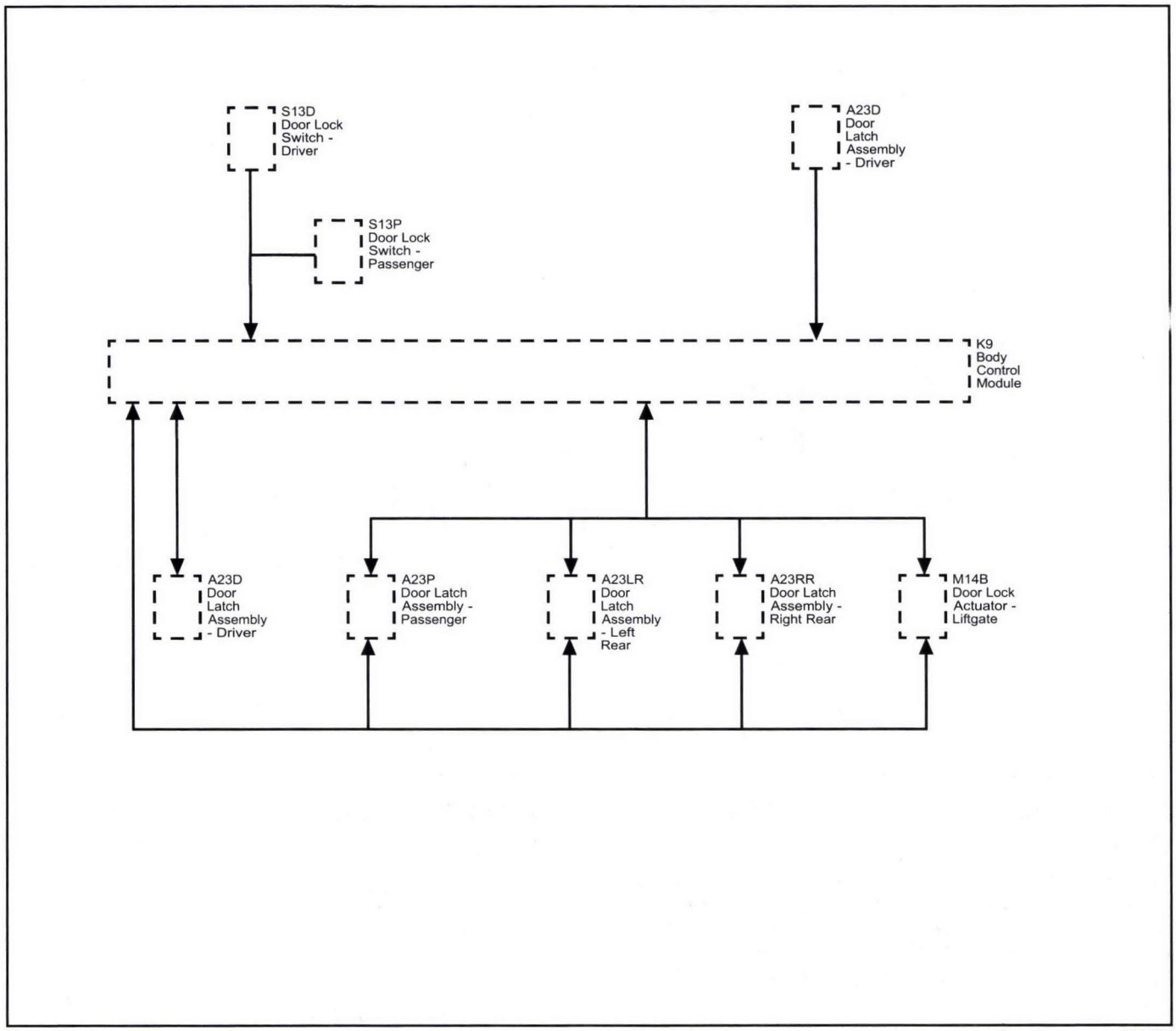
Power Door Locks Description and Operation

Door Lock System Components

The power door lock system consists of the following components:

- Driver door lock switch
- Passenger door lock switch
- Body control module (BCM)
- Driver door latch
- Passenger door latch
- Left rear door latch
- Right rear door latch

Power Door Locks Block Diagram



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Door Lock Switch Operation

The body control module supplies a 12 V signal to each of the door lock and door unlock signal circuits. When the door lock switches are in the open position, the voltage level in the signal circuit will be near 12 V. When any door lock switch is pressed to the lock or unlock position, the voltage level in the appropriate signal circuit will drop to 0 V and the BCM will detect the voltage drop and command the door latches to perform the requested lock or unlock command.

Door Lock and Unlock Operation

The body control module powers the reversible door latch assemblies by providing battery positive voltage and ground to the appropriate lock and unlock control circuits of the door latch assemblies. The lock and unlock control circuits of the rear doors and passenger door latch assemblies are all connected together. When the door latch assemblies are not active, all actuator lock and unlock control circuits are supplied a floating voltage door driver by the BCM. Transitioning of the lock actuators to the lock or unlocked position depends upon which control circuits receive voltage and which control circuits receive ground.

The following three circuits are used to operate the lock:

- Driver door only unlock
- All passenger doors unlock
- All doors lock

Rear Hatch/Gate Description and Operation

Liftgate

The liftgate may be operated by one of the following methods:

- Inserting the key into the liftgate lock.
- Operating the power door lock switches.
- Operating the rear hatch lock switch.
- Using the keyless entry fob.

Functional Operation

The liftgate operates in the same manner as the power door locks. If the vehicle is equipped with power door locks, the lock and unlock circuits for the liftgate are shared with the passenger lock/unlock control circuits. If the vehicle is not equipped with power door locks, the liftgate will have it's own lock/unlock switch and will have it's own lock and unlock control circuits commanded by the BCM.

Wipers and Washers

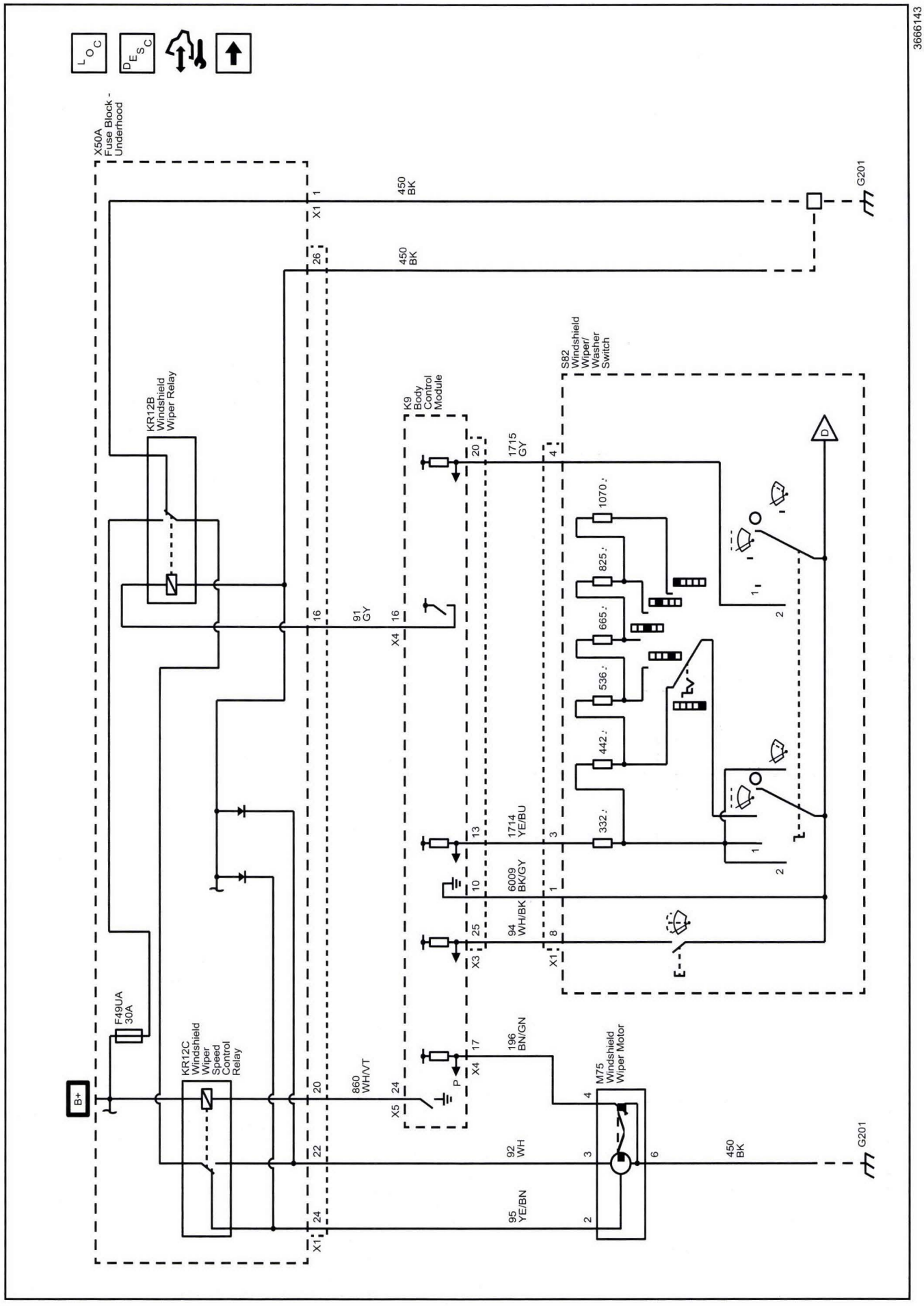
Specifications

Fastener Tightening Specifications

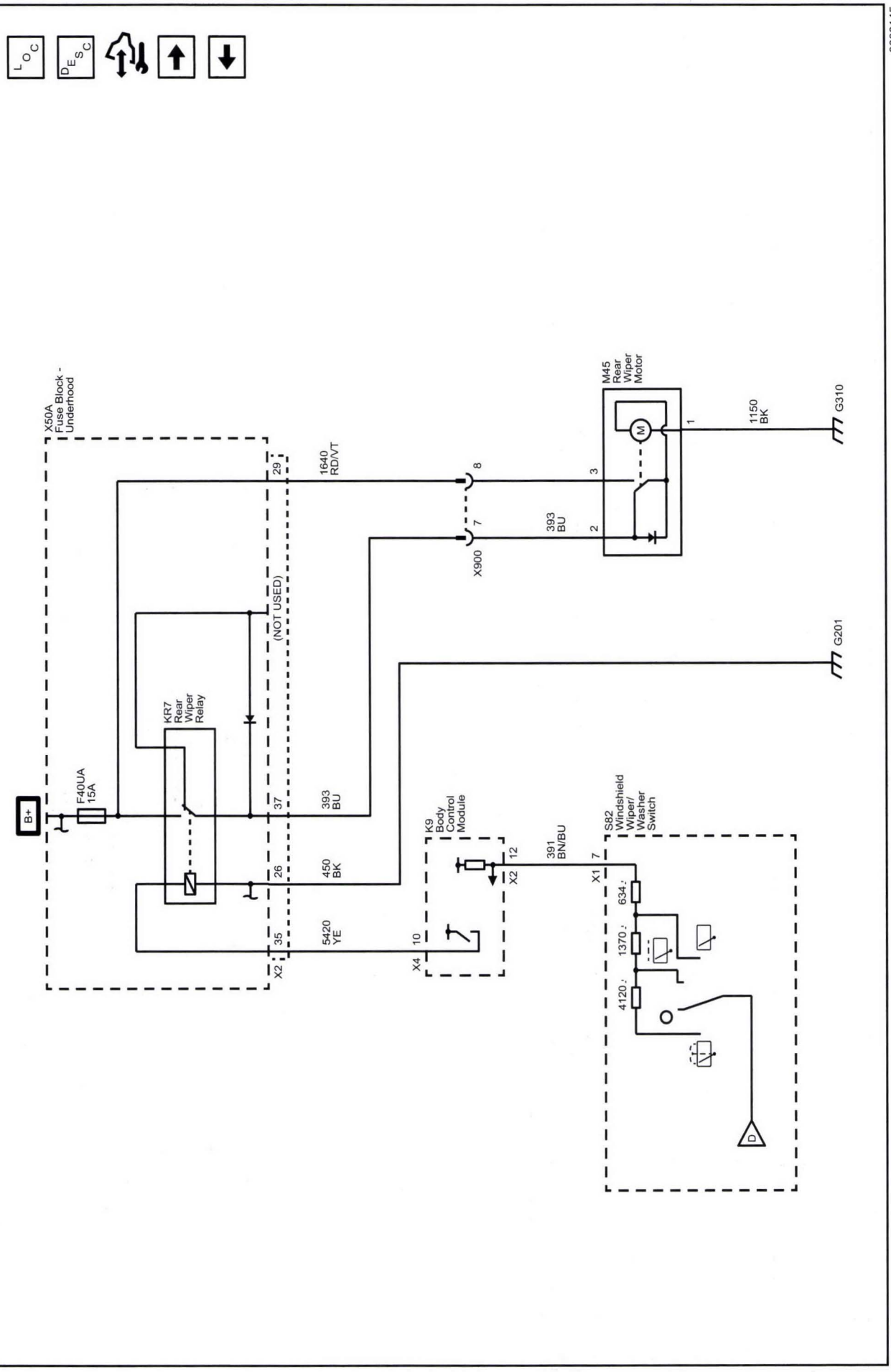
Application	Specification	
	Metric	English
Rear Window Wiper Arm Nut	9 N•m	80 lb in
Rear Window Wiper Motor Bolt	8 N•m	71 lb in
Windshield Washer Solvent Container Nut	9 N•m	80 lb in
Windshield Wiper Arm Nut	24 N•m	18 lb in
Windshield Wiper Motor Bolt	13 N•m	10 lb ft
Windshield Wiper Transmission Frame Bolt	10 N•m	89 lb in

Schematic and Routing Diagrams

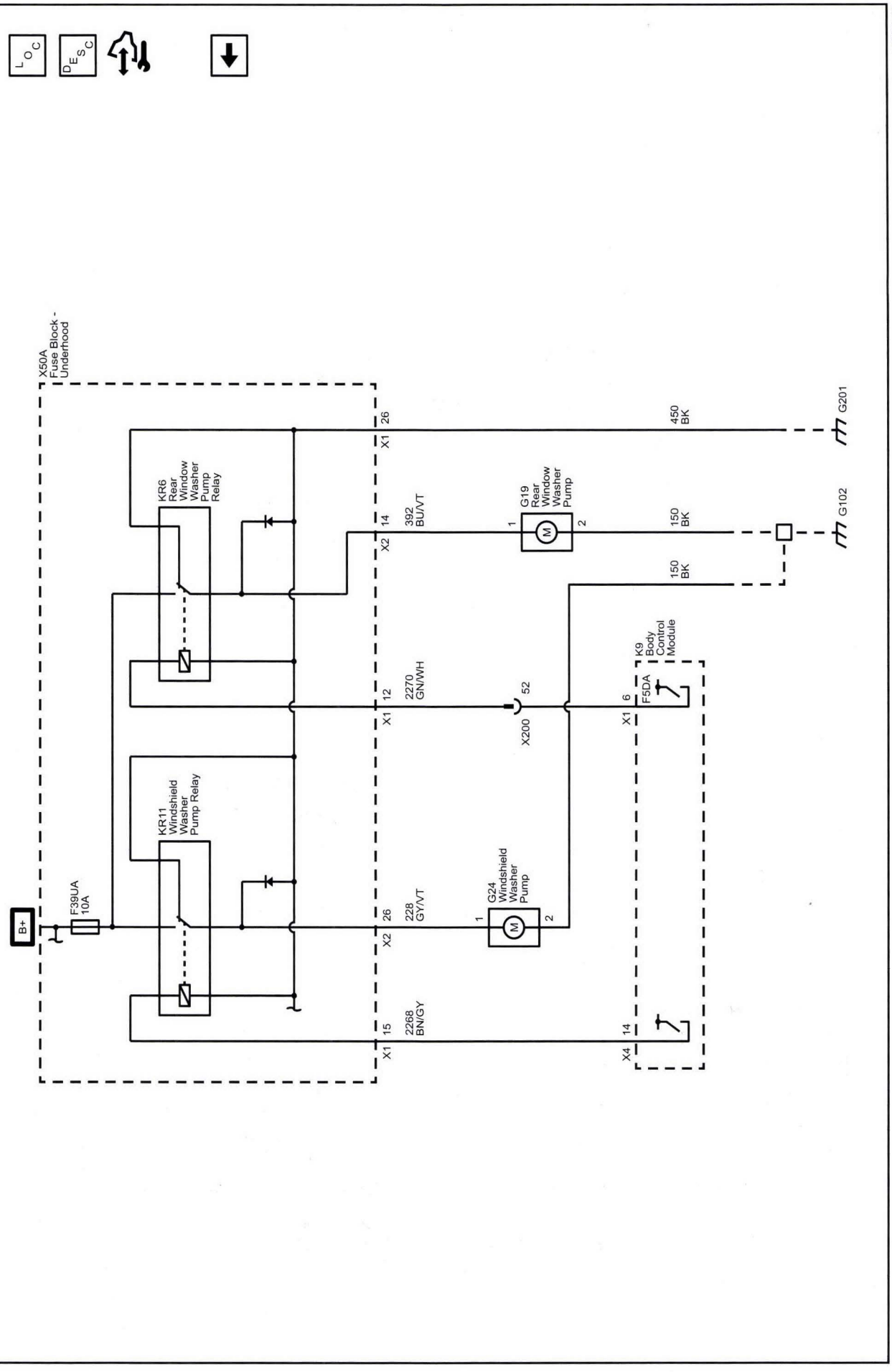
Wiper/Washer Schematics (Controls and Front Wipers)



Wiper/Washer Schematics (Controls and Rear Wiper)



Wiper/Washer Schematics (Front and Rear Washers)



Diagnostic Information and Procedures

DTC B370B

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptor

DTC B370B 02: Rear Wiper Function Control Circuit Short to Ground
DTC B370B 01: Rear Wiper Function Control Circuit Short to Voltage
DTC B370B 04: Rear Wiper Function Control Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Rear Wiper Switch Signal	2	1	1	—
Rear Wiper Motor Control	1	1	2	—
Rear Window Wiper Relay Control	B370B 02	B370B 04	B370B 01	—
Rear Wiper Relay Control	1	1	2	—
Rear Wiper Motor Ground	—	1	1	—
Rear Wiper Relay Ground	—	1	—	—
1. Rear Wiper Inoperative. 2. Rear Wiper Always ON.				

Circuit/System Description

The body control module (BCM) controls the single speed rear wiper motor by its active high output to the external rear wiper motor relay. When the BCM activates its output and applies battery to the coil of the relay, the relay energizes, allowing battery voltage from the fuse to be applied through the switched contacts of the rear wiper motor relay to the control input of the rear wiper motor . The motor then operates continuously at low speed.

Conditions for Running the DTC

- Vehicle in Service Mode
- The system voltage is between 9–16 V.

Conditions for Setting the DTC

A short to ground or an open/high resistance is detected in the rear window wiper control circuit.

Action Taken When the DTC Sets

Rear wiper operation is suspended.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Reference Information

Schematic Reference

Wiper/Washer Schematics on page 4-287

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Wiper/Washer System Description and Operation on page 4-336

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC B1517 is set in the K9 Body Control Module.

⇒ **If the DTC B1517 is set**

Refer to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92*.

⇓ **If the DTC B1517 is not set**

3. Verify the scan tool Rear Wiper Switch parameter changes between Off and On when turning the rear wipers ON and OFF..

⇒ **If the parameter does not change**

Refer to Circuit/System Testing – Rear Wiper/ Washer Switch Malfunction.

⇓ **If the parameter changes**

4. Verify the Rear Wiper Motor turns On when commanding the Rear Wiper Active with a scan tool.

⇒ **If the Rear Wiper Motor does not turn ON**

Refer to Circuit/System Testing – Rear Wiper Motor Malfunction

⇓ **If the Rear Wiper Motor turns ON**

5. All OK.

Circuit/System Testing

Rear Wiper/Washer Switch Malfunction

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch. It may take up to 11 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 1 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the low reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Test for greater than 8 V between the signal circuit terminal 7 and ground.

⇒ **If less than 8 V**

4.1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit and ground

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If 8 V or greater**

5. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
6. Test for less than 1 V between the S82 Windshield Wiper/Washer Switch signal circuit terminal 7 and ground.

⇒ **If 1 V or greater**

Repair the short to voltage on the circuit.

⇓ **If less than 1 V**

7. Test or replace the S82 Windshield Wiper/Washer Switch.

Rear Wiper Motor Malfunction

1. Vehicle OFF, and all vehicle systems OFF. Disconnect the harness connector at the M45 Rear Wiper Motor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.

⇒ **If 10 Ω or greater**

2.1. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 3 and the ground circuit terminal 1.

⇒ **If the test lamp does not illuminate**

4.1. Vehicle OFF, remove the test lamp. Disconnect the X2 harness connector at the X50A Fuse Block – Underhood.

4.2. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the X50A Fuse Block – Underhood.

⇓ **If the test lamp illuminates**

5. Connect a test lamp between the control circuit terminal 2 and the ground circuit terminal 1.
6. Verify the test lamp does NOT turn ON and OFF when commanding the Rear Wiper On and Off with a scan tool.

⇒ **If the test lamp turns ON and OFF**

Test or replace the M45 Rear Wiper Motor.

⇓ **If the test lamp does not turn ON and OFF**

7. Vehicle OFF, connect the harness connector at the M45 Rear Wiper Motor. Disconnect the X2 harness connector at the X50A Fuse Block – Underhood, It may take up to 2 min for all vehicle systems to power down.

8. Test for less than 10 Ω between each ground circuit listed below and ground:
   - Terminal 39
   - Terminal 44

⇒ **If 10 Ω or greater**

8.1. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

9. Vehicle in Service Mode.
10. Verify the M45 Rear Wiper Motor is not activated.

⇒ **If the M45 Rear Wiper Motor is activated**

10.1. Vehicle OFF, disconnect the harness connector at the M45 Rear Wiper Motor, vehicle in Service Mode.

10.2. Test for less than 1 V between the control circuit terminal 2 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the M45 Rear Wiper Motor.

⇓ **If the M45 Rear Wiper Motor is not activated**

11. Connect a 20 A fused jumper wire between both of the circuits listed below and B+:
    - B+ Circuit Terminal 29
    - Control Circuit Terminal 37
12. Verify the M45 Rear Wiper Motor activates.

⇒ **If the M45 Rear Wiper Motor does not activate**

12.1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the M45 Rear Wiper Motor, vehicle in Service Mode.

12.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than Infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

12.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the M45 Rear Wiper Motor.

⇓ **If the M45 Rear Wiper Motor activates**

13. Vehicle OFF, connect the X2 harness connector at the X50A Fuse Block – Underhood. Disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
14. Verify the M45 Rear Wiper Motor is not activated.

⇒ **If the M45 Rear Wiper Motor is activated**

14.1. Vehicle OFF, disconnect the X2 harness connector at the X50A Fuse Block – Underhood, vehicle in Service Mode.

14.2. Test for less than 1 V between the control circuit terminal 35 and B+.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the X50A Fuse Block – Underhood.

⇓ **If the M45 Rear Wiper Motor is not activated**

15. Connect a 10 A fused jumper wire between the control circuit terminal 10 and B+.
16. Verify the M45 Rear Wiper Motor activates.

⇒ **If the M45 Rear Wiper Motor does not activate**

16.1. Vehicle OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block – Underhood.

16.2. Test for infinite resistance between the control circuit terminal 27 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If less than infinite resistance

16.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the X50A Fuse Block – Underhood.

⇓ **If the M45 Rear Wiper Motor activates**

17. Test or replace the K9 Body Control Module.

Component Testing

Windshield Wiper/Washer Switch

1. Vehicle OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch.
2. Test for infinite resistance between the signal terminal 7 and the low reference terminal 1 with the rear window washer switch in the open position.

⇒ **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.

⇓ **If infinite resistance**

3. Verify the resistance reading is within the range specified below between the signal circuit terminal 7 and the low reference circuit terminal 1 by cycling the switch between Rear Wiper position and Rear Washers position.
   - Rear Wiper : 624-644Ω
   - Rear Wiper Sweep : 1.99-2.01kΩ
   - Rear Washer : 6.11-6.13kΩ

⇒ **If not within range specified**

Replace the S82 Windshield Wiper/Washer Switch.

⇓ **If within range specified**

4. All OK

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Rear Window Wiper Motor Replacement on page 4-333*
- *Windshield Wiper and Washer Switch Replacement on page 4-319*
- *Control Module References on page 6-3* or BCM replacement, programming and setup

DTC B3715 or B3875

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B3715: Windshield Wiper Relay Circuit

DTC B3875: Windshield Wiper High Speed Relay Circuit

For symptom byte information, refer to *Symptom Byte List on page 6-117*.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Windshield Wiper Relay Control	B3715 02	B3715 04	B3715 01	—
Windshield Wiper Speed Control Relay Control	B3875 02	B3875 04	B3875 01	—

Circuit/System Description

The windshield wiper motor is controlled by the body control module (BCM) through the windshield wiper replay and the windshield wiper speed control relay. When low speed windshield wiper operation is requested, the BCM will apply voltage to the windshield wiper relay control circuit. This will cause the contacts in the windshield wiper relay to close and apply B+ to the windshield wiper motor through the windshield wiper low speed control circuit, enabling low speed wiper operation. When high speed windshield wiper operation is requested, the body control module continues to apply voltage to the windshield wiper relay control circuit and also applies ground to the windshield wiper speed control relay control circuit. This will cause the contacts in the windshield wiper speed control relay to close and apply B+ to the windshield wiper motor through the windshield wiper high speed control circuit, enabling high speed wiper operation. When the windshield wiper request is no longer present, the contacts in the windshield wiper relay and windshield wiper speed control relay will open, removing B+ from the wiper motor control circuits. The windshield wiper motor will continue to operate using a discrete B+ circuit provided by the BCM until the wipers are in the park position.

Conditions for Running the DTC

- The DTC runs only when a wiper output is actively being requested by the BCM.
- The system voltage is between 9–16 V.

Conditions for Setting the DTC

B3715 01

A short to voltage is detected in the windshield wiper relay control circuit.

B3715 02

A short to ground is detected in the windshield wiper relay control circuit.

B3715 04

An open or high resistance is detected in the windshield wiper relay control circuit.

B3875 01

A short to voltage is detected in the windshield wiper high speed relay control circuit.

B3875 02

A short to ground is detected in the windshield wiper high speed relay control circuit.

B3875 04

An open or high resistance is detected in the windshield wiper high speed relay control circuit.

Action Taken When the DTC Sets

The BCM will not activate the wiper output.

Conditions for Clearing the DTC

- A current DTC will clear when the condition for setting the fault is no longer present.
- A history DTC will clear after 50 consecutive ignition cycles without a fault present.

Reference Information

Schematic Reference

Wiper/Washer Schematics on page 4-287

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Wiper/Washer System Description and Operation on page 4-336

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the M75 Windshield Wiper Motor changes between Off, Low, and High when cycling the S82 Windshield Wiper/Washer Switch between Off, Low, and High.

⇒ **If the Windshield Wiper Motor does not cycle between Off, Low, and High**

Refer to Circuit/System Testing

⇓ **If the Windshield Wiper Motor cycles between Off, Low, and High**

3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the M75 Windshield Wiper Motor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 6 and ground:

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Windshield Wiper Park Switch parameter is Inactive.

⇒ **If not Inactive**

4.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the M75 Windshield Wiper Motor park switch signal circuit terminal 4 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 4 and ground circuit terminal 6.
6. Verify the scan tool Windshield Wiper Park Switch parameter is Active.

⇒ **If not Active**

6.1. Vehicle OFF, remove the jumper wire, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

7. Connect a test lamp between the control circuit terminal 2 and ground, vehicle in Service Mode.
8. Verify the test lamp does NOT turn ON and OFF when commanding the Windshield Washer Relay Low and Off with a scan tool.

⇒ **If the test lamp turns ON and OFF**

Test or replace the M75 Windshield Wiper Motor.

⇓ **If the test lamp does not turn ON and OFF**

9. Connect a test lamp between the following control circuits and ground, ignition ON.
   - Windshield Wiper Motor Low Speed Control Circuit Terminal 3
   - Windshield Wiper Motor High Speed Control Circuit Terminal 2
10. Verify the test lamp does NOT turn ON and OFF when commanding the Windshield Washer Relay High and Off with a scan tool.

⇒ **If the test lamp turns ON and OFF**

Test or replace the M75 Windshield Wiper Motor.

⇓ **If the test lamp does not turn ON and OFF**

11. Vehicle OFF and all vehicle systems OFF, connect the harness connector at the M75 Windshield Wiper Motor. Disconnect the X1 harness connector at the X50A Fuse Block - Underhood. It may take up to 2 min for all vehicle systems to power down.

12. Test for less than 10 Ω between each ground circuit listed below and ground:
    - Terminal 1
    - Terminal 26

⇒ **If 10 Ω or greater**

12.1. Vehicle OFF.

12.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

13. Vehicle in Service Mode.
14. Verify the M75 Windshield Wiper Motor is not activated.

⇒ **If the M75 Windshield Wiper Motor is activated**

14.1. Vehicle OFF, disconnect the harness connector at the M75 Windshield Wiper Motor, vehicle in Service Mode.

14.2. Test for less than 1 V between each control circuit listed below and ground:
- Terminal 2
- Terminal 3

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the M75 Windshield Wiper Motor.

⇓ **If the M75 Windshield Wiper Motor is not activated**

15. Connect a 20 A fused jumper wire between each control circuit listed below, one at a time, and B+:
    - Terminal 24
    - Terminal 22
16. Verify the M75 Windshield Wiper Motor activates.

⇒ **If the M75 Windshield Wiper Motor does not activate**

16.1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the M75 Windshield Wiper Motor.

16.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than Infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

16.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the M75 Windshield Wiper Motor.

⇓ **If the M75 Windshield Wiper Motor activates**

17. Vehicle OFF, connect the X1 harness connector at the X50A Fuse Block – Underhood. Disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
18. Verify the M75 Windshield Wiper Motor low speed is not activated.

⇒ **If the M75 Windshield Wiper Motor low speed is activated**

18.1. Vehicle OFF, disconnect the X1 harness connector at the X50A Fuse Block – Underhood, vehicle in Service Mode.

18.2. Test for less than 1 V between the X1 harness connector at the X50A Fuse Block – Underhood control circuit terminal 16 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the X50A Fuse Block – Underhood.

⇓ **If the M75 Windshield Wiper Motor low speed is not activated**

19. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
20. Verify the M75 Windshield Wiper Motor High Speed is not activated.

⇒ **If the M75 Windshield Wiper Motor high speed is activated**

20.1. Vehicle OFF, disconnect the X1 harness connector at the X50A Fuse Block – Underhood, vehicle in Service Mode.

20.2. Test for infinite resistance between the X1 harness connector at the X50A Fuse Block – Underhood control circuit terminal 20 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the X50A Fuse Block – Underhood.

⇓ **If the M75 Windshield Wiper Motor high speed is not activated**

21. Connect a 10 A fused jumper wire between the control circuit terminal 16 X4 and B+.
22. Verify the M75 Windshield Wiper Motor activates.

⇒ **If the M75 Windshield Wiper Motor does not activate**

22.1. Vehicle OFF, remove the jumper wire, disconnect the X1 harness connector at the X50A Fuse Block – Underhood.

22.2. Test for infinite resistance between the X1 harness connector at the X50A Fuse Block – Underhood control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If less than infinite resistance

22.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the X50A Fuse Block – Underhood.

⇓ **If the M75 Windshield Wiper Motor activates**

23. Connect a 10 A fused jumper wire between the control circuit terminal 24 X5 and ground.
24. Verify the M75 Windshield Wiper Motor activates.

⇒ **If the M75 Windshield Wiper Motor does not activate**

24.1. Vehicle OFF, remove the jumper wire, disconnect the X1 harness connector at the X50A Fuse Block – Underhood.

24.2. Test for less than 1 V between the X1 harness connector at the X50A Fuse Block – Underhood control circuit and ground.

⇒ If 1 V or greater, repair the short to ground on the circuit.

⇓ If less than 1 V

24.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the X50A Fuse Block – Underhood.

⇓ **If the M75 Windshield Wiper Motor activates**

25. Replace the K9 Body Control Module.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Windshield Wiper Motor Replacement on page 4-332*
- *Control Module References on page 6-3* for BCM replacement, programming and setup

DTC B3811

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptor

DTC B3811 02: Rear Washer Relay Circuit Short to Ground
DTC B3811 01: Rear Washer Relay Circuit Short to Voltage
DTC B3811 04: Rear Washer Relay Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Rear Washer Switch Control	2	3	3	—
Rear Washer Relay Control	B3811 02	B3811 04	B3811 01	—
Rear Washer Pump Control	1	1	2	—
Rear WasherPump Ground	—	1	1, 2	—

1. Rear Washer Inoperative.
2. Rear Washer Always ON.
3. Rear Wipers and Washers Inoperative.

Circuit/System Description

When the body control module (BCM) detects that the rear wiper/wash switch has activated the momentary Wash switch, it activates a high side drive output which supplies battery to the coil of the rear washer pump relay. This energizes the relay, which switches battery power to the washer pump motor. The BCM will also activate continuous low speed windshield wipers as described above. This Washer and Wiper operation shall be continued so long as the switch remains active. Upon termination, the rear wash motor will be deactivated and the wiper shall move to its park position and deactivate.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The system voltage is between 9–16 V.

Conditions for Setting the DTC

A short to ground, short to voltage, or an open/high resistance is detected in the rear washer relay control circuit.

Action Taken When the DTC Sets

Washer operation is suspended.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- A history DTC will clear after 50 consecutive ignition cycles without a fault present.

Reference Information

Schematic Reference

Wiper/Washer Schematics on page 4-287

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Wiper/Washer System Description and Operation on page 4-336

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Rear Wiper Switch parameter changes between Off and On when pressing the windshield washer switch.

⇒ **If the parameter does not change**

Refer to *Rear Wiper System Malfunction on page 4-312*

⇓ **If the parameter changes**

3. Verify the rear window washers turn On when commanding the Rear Washer Relay Active with a scan tool.

⇒ **If the Rear Window Washers do not turn ON**

Refer to Circuit/System Testing

⇓ **If the Rear Window Washers turn ON**

4. All OK.

Circuit/System Testing

1. Vehicle OFF, and all vehicle systems OFF. Disconnect the harness connector at the G19 Rear Window Washer Pump. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.

⇒ **If 10 Ω or greater**

2.1. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Connect a test lamp between the control circuit terminal 1 and the ground circuit terminal 2, vehicle in Service Mode.
4. Verify the test lamp does NOT turn ON and OFF when commanding the Rear Washer Relay Active and Inactive with a scan tool.

⇒ **If the test lamp turns ON and OFF**

Test or replace the G19 Rear Window Washer Pump.

⇓ **If the test lamp does not turn ON and OFF**

5. Vehicle OFF, connect the harness connector at the G19 Rear Window Washer Pump. Disconnect the X2 harness connector at the X50A Fuse Block – Underhood, It may take up to 2 min for all vehicle systems to power down.
6. Test for less than 10 Ω between the ground circuit terminal 39 and ground.

⇒ **If 10 Ω or greater**

6.1. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

7. Vehicle OFF, connect the X2 harness connector at the X50A Fuse Block – Underhood. Disconnect the X1 harness connector at the X50A Fuse Block – Underhood, vehicle in Service Mode.
8. Verify the G19 Rear Window Washer Pump is not activated.

⇒ **If the G19 Rear Window Washer Pump is activated**

8.1. Vehicle OFF, disconnect the harness connector at the G19 Rear Window Washer Pump, vehicle in Service Mode.

8.2. Test for less than 1 V between the control circuit terminal 1 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the G19 Rear Window Washer Pump.

⇓ **If the G19 Rear Window Washer Pump is not activated**

9. Connect a 20 A fused jumper wire between the control circuit terminal 14 and B+.
10. Verify the G19 Rear Window Washer Pump activates.

⇒ **If the G19 Rear Window Washer Pump does not activate**

10.1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the G19 Rear Window Washer Pump, vehicle in Service Mode.

10.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than Infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

10.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the G19 Rear Window Washer Pump.

⇓ **If the G19 Rear Window Washer Pump activates**

11. Vehicle OFF, connect the X1 harness connector at the X50A Fuse Block – Underhood. Disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
12. Verify the G19 Rear Window Washer Pump is not activated.

⇒ **If the G19 Rear Window Washer Pump is activated**

12.1. Vehicle OFF, disconnect the X2 harness connector at the X50A Fuse Block – Underhood, vehicle in Service Mode.

12.2. Test for less than 1 V between the control circuit terminal 4 and B+.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the X50A Fuse Block – Underhood.

⇓ **If the G19 Rear Window Washer Pump is not activated**

13. Connect a 10 A fused jumper wire between the control circuit terminal 6 and B+.
14. Verify the G19 Rear Window Washer Pump activates.

⇒ **If the G19 Rear Window Washer Pump does not activate**

14.1. Vehicle OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block – Underhood.

14.2. Test for infinite resistance between the control circuit terminal 4 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If less than infinite resistance

14.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the X50A Fuse Block – Underhood.

⇓ **If the G19 Rear Window Washer Pump activates**

15. Replace the K9 Body Control Module.

Component Testing

Windshield Wiper/Washer Switch

1. Vehicle OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch.
2. Test for infinite resistance between the signal terminal 7 and the low reference terminal 1 with the rear window washer switch in the open position.

⇒ **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.

⇓ **If infinite resistance**

3. Verify the resistance reading is within the range specified below between the signal circuit terminal 7 and the low reference circuit terminal 2 by cycling the switch between Rear Wiper position and Rear Washers position.
   - Rear Wiper : 624-644Ω
   - Rear Wiper Sweep : 1.99-2.01kΩ
   - Rear Washer : 6.11-6.13kΩ

⇒ **If not within range specified**

Replace the S82 Windshield Wiper/Washer Switch.

⇓ **If within range specified**

4. All OK

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Relay Replacement (Within an Electrical Center) on page 11-953* or *Relay Replacement (Attached to Wire Harness) on page 11-953*
- *Windshield Washer Pump Replacement on page 4-325*
- *Windshield Wiper and Washer Switch Replacement on page 4-319*
- *Control Module References on page 6-3* for BCM replacement, programming and setup

DTC B3873

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B3873 01: Front Washer Relay Circuit Short to Battery
DTC B3873 02: Front Washer Relay Circuit Short to Ground
DTC B3873 04: Front Washer Relay Circuit Open Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Windshield Washer Switch Signal	2	1	—	—
Windshield Washer Pump Control	1	1	2	—
Windshield Washer Relay Control	B3873 02	B3873 04	B3873 01	—
Windshield Washer Pump Ground	—	1	—	—
Windshield Wiper/Washer Switch Low Reference	—	1	—	—
1. Washer Inoperative 2. Washer Always ON				

Circuit/System Description

The body control module (BCM) controls the windshield washer pump based on an input from the windshield wiper/washer switch. The BCM monitors the washer switch through the windshield washer switch signal circuit. When the washer switch is closed, low reference is supplied to the windshield washer switch signal circuit. When this is the case, the BCM will command the windshield washer pump and the low speed wipers on.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The system voltage is between 9–16 V.

Conditions for Setting the DTC

- A short to ground or an open/high resistance is detected in the windshield washer relay control circuit.
- A short to voltage is detected in the windshield washer relay control circuit.

Action Taken When the DTC Sets

Washer operation is suspended.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Reference Information

Schematic Reference

Wiper/Washer Schematics on page 4-287

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Wiper/Washer System Description and Operation on page 4-336

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC B1517 is set in the K9 Body Control Module.

⇒ **If the DTC B1517 is set**

Refer to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92*.

⇓ **If the DTC B1517 is not set**

3. Verify the scan tool Windshield Washer Switch parameter changes between Active and Inactive when pressing the windshield washer switch.

⇒ **If the parameter does not change**

Refer to Circuit/System Testing – Windshield Wiper/Washer Switch Malfunction.

⇓ **If the parameter changes**

4. Verify the windshield washers turn On when commanding the Windshield Washer Relay Active with a scan tool.

⇒ **If the Windshield Washers do not turn ON**

Refer to Circuit/System Testing – Windshield Washer Pump Malfunction

⇓ **If the Windshield Washers turn ON**

5. All OK.

Circuit/System Testing

Windshield Wiper/Washer Switch Malfunction

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch. It may take up to 11 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 1 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the low reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Windshield Washer Switch parameter is Inactive.

⇒ **If not Inactive**

4.1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit terminal 8 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 8 and the low reference circuit terminal 1.
6. Verify the scan tool Windshield Washer Switch parameter is Active.

⇒ **If not Active**

6.1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K9 Body Control Module, vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

7. Test or replace the S82 Windshield Wiper/Washer Switch.

Windshield Washer Pump Malfunction

1. Vehicle OFF, and all vehicle systems OFF. Disconnect the harness connector at the G24 Windshield Washer Pump. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.

⇒ **If 10 Ω or greater**

2.1. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Connect a test lamp between the control circuit terminal 1 and the ground circuit terminal 2, vehicle in Service Mode.
4. Verify the test lamp does NOT turn ON and OFF when commanding the Windshield Washer Relay Active and Inactive with a scan tool.

⇒ **If the test lamp turns ON and OFF**

Test or replace the G24 Windshield Washer Pump.

⇓ **If the test lamp does not turn ON and OFF**

5. Vehicle OFF, connect the harness connector at the G24 Windshield Washer Pump. Disconnect the X1 harness connector at the X50A Fuse Block – Underhood, It may take up to 2 min for all vehicle systems to power down.

6. Test for less than 10 Ω between the ground circuit terminal 26 and ground.

⇒ **If 10 Ω or greater**

6.1. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

7. Vehicle OFF, connect the X1 harness connector at the X50A Fuse Block - Underhood and disconnect the X2 harness connector at the X50A Fuse Block - Underhood, vehicle in Service Mode..
8. Verify the G24 Windshield Washer Pump is not activated.

⇒ **If the G24 Windshield Washer Pump is activated**

8.1. Vehicle OFF, disconnect the harness connector at the G24 Windshield Washer Pump, vehicle in Service Mode.

8.2. Test for less than 1 V between the control circuit terminal 1 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the G24 Windshield Washer Pump.

⇓ **If the G24 Windshield Washer Pump is not activated**

9. Connect a 20 A fused jumper wire between the control circuit terminal 26 and B+.
10. Verify the G24 Windshield Washer Pump activates.

⇒ **If the G24 Windshield Washer Pump does not activate**

10.1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the G24 Windshield Washer Pump, vehicle in Service Mode.

10.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than Infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

10.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the G24 Windshield Washer Pump.

⇓ **If the G24 Windshield Washer Pump activates**

11. Vehicle OFF, connect the X2 harness connector at the X50A Fuse Block – Underhood. Disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
12. Verify the G24 Windshield Washer Pump is not activated.

⇒ **If the G24 Windshield Washer Pump is activated**

12.1. Vehicle OFF, disconnect the X1 harness connector at the X50A Fuse Block – Underhood, vehicle in Service Mode.

12.2. Test for less than 1 V between the control circuit terminal 15 and B+.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the X50A Fuse Block – Underhood.

⇓ **If the G24 Windshield Washer Pump is not activated**

13. Connect a 10 A fused jumper wire between the control circuit terminal 14 and B+.
14. Verify the G24 Windshield Washer Pump activates.

⇒ **If the G24 Windshield Washer Pump does not activate**

14.1. Vehicle OFF, remove the jumper wire, disconnect the X1 harness connector at the X50A Fuse Block – Underhood.

14.2. Test for infinite resistance between the control circuit terminal 15 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If less than infinite resistance

14.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the X50A Fuse Block – Underhood.

⇓ **If the G24 Windshield Washer Pump activates**

15. Replace the K9 Body Control Module.

Component Testing

Windshield Wiper/Washer Switch

1. Vehicle OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch.
2. Test for infinite resistance between the signal terminal 8 and the low reference terminal 1 with the switch in the open position.

⇒ **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.

⇓ **If infinite resistance**

3. Test for less than 2 Ω between the signal circuit terminal 8 and the low reference circuit terminal 1 with the switch in the closed position.

⇒ **If 2 Ω or greater**

Replace the S82 Windshield Wiper/Washer Switch.

⇓ **If less than 2 Ω**

4. All OK

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Windshield Washer Pump Replacement on page 4-325*
- *Relay Replacement (Within an Electrical Center) on page 11-953* or *Relay Replacement (Attached to Wire Harness) on page 11-953*
- *Windshield Wiper and Washer Switch Replacement on page 4-319*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup.

Symptoms - Wiper/Washer Systems

Note: The following steps must be completed before using the symptom tables:

1. Perform *Diagnostic System Check - Vehicle on page 6-91* , in order to verify that all of the following conditions are true:
   - No DTCs are set.
   - The control modules can communicate via the serial data link.
2. Refer to *Wiper/Washer System Description and Operation on page 4-336* in order to familiarize yourself with the system functions.

Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the windshield wiper/washer system. Refer to *Checking Aftermarket Accessories on page 11-871*.
- Inspect the easily accessible or visible system components for obvious damage or conditions which may cause the symptom.
- Inspect the washer fluid reservoir for the proper fluid level.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to *Testing for Intermittent Conditions and Poor Connections on page 11-877*.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- *Windshield Wiper System Malfunction on page 4-304*
- *Washer Malfunction on page 4-309*
- *Rear Washer System Malfunction on page 4-316*
- *Rear Wiper System Malfunction on page 4-312*

Windshield Wiper System Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Windshield Wiper Switch Signal terminal 3	1	1	1	—
Windshield Wiper Switch Signal terminal 4	4	2	—	—
Windshield Wiper Motor Park Signal	3	3	—	—
Windshield Wiper Motor Relay Coil Supply Voltage Control	B3715 02	B3715 04	B3715 01	—
Front Windshield Wiper Switch High Signal	B3875 02	B3875 04	B3875 01, 4	—
Windshield Wiper High Speed Motor Control	2	2	4	—
Front Wiper Low Speed Motor Control	1	1	4	—
Windshield Wiper Switch Low Reference	—	1, 2	—	—
Windshield Wiper Motor Ground	—	1, 2, 3	—	—

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Windshield Wiper Relay Ground	—	1	—	—
1. Delay or Low Speed Wipers Inoperative 2. High Speed Wipers Inoperative 3. Wipers Do Not Park 4. Wipers Always On				

Circuit/System Description

The body control module (BCM) controls the windshield wiper motor based on inputs from the windshield wiper/washer switch. The BCM monitors the windshield wiper/washer switch through two separate signal circuits and a low reference circuit. The windshield wiper/washer switch uses a resistor ladder to determine low speed and intermittent operation. The BCM applies and monitors voltage on the windshield wiper switch signal circuit. When the wiper switch is placed in the low speed or intermittent position, the voltage is pulled down through a different resistor in the resistor ladder, reducing the voltage seen at the BCM. The BCM will respond by commanding on the low speed or intermittent wipers. The high speed wipers are controls through a discrete signal circuit. With the windshield wiper/washer switch is in the high speed position, the windshield wiper high speed switch signal circuit is pulled directly to ground. The BCM will respond by commanding on the high speed wipers.

The windshield wiper motor is controlled by the BCM through the windshield wiper replay and the windshield wiper speed control relay. A constant ground is supplied to the rear wiper motor. When low speed windshield wiper operation is requested, the BCM will apply voltage to the windshield wiper relay control circuit. This will cause the contacts in the windshield wiper relay to close and apply B+ to the windshield wiper motor through the windshield wiper low speed control circuit, enabling low speed wiper operation. When high speed windshield wiper operation is requested, the BCM continues to apply voltage to the windshield wiper relay control circuit and also applies ground to the windshield wiper speed control relay control circuit. This will cause the contacts in the windshield wiper speed control relay to close and apply B+ to the windshield wiper motor through the windshield wiper high speed control circuit, enabling high speed wiper operation. When the windshield wiper request is no longer present, the contacts in the windshield wiper relay and windshield wiper speed control relay will open, removing B+ from the wiper motor control circuits. The windshield wiper motor will continue to operate using a discrete B+ circuit provided by the BCM until the wipers are in the park position.

Reference Information

Schematic Reference

Wiper/Washer Schematics on page 4-287

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Wiper/Washer System Description and Operation on page 4-336

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Windshield Wiper High Speed Switch parameter changes between Active and Inactive when activating the high speed windshield wipers.

⇒ **If the parameter does not change**

Refer to Circuit/System Testing – Windshield Wiper/Washer Switch Malfunction.

⇓ **If the parameter changes**

3. Verify the scan tool Windshield Wiper Switch parameter changes between Off and Low when activating the low speed windshield wipers.

⇒ **If the parameter does not change**

Refer to Circuit/System Testing – Windshield Wiper/Washer Switch Malfunction.

⇓ **If the parameter changes**

4. Verify the scan tool Windshield Wiper Switch parameter changes between Delay 1 and Delay 5 when cycling the intermittent speed windshield wipers.

⇒ **If the parameter does not change**

Test or replace the S82 Windsheild Wiper/Washer Switch.

⇓ **If the parameter changes**

5. Verify the M75 Windshield Wiper Motor changes between Off, Low, and High when cycling the S82 Windshield Wiper/Washer Switch between Off, Low, and High.

⇒ **If the Windshield Wiper Motor does not cycle between Off, Low, and High**

Refer to Circuit/System Testing – Windshield Wiper Motor Malfunction

⇓ **If the Windshield Wiper Motor cycles between Off, Low, and High**

6. Vehicle OFF.
7. Verify the scan tool Windshield Wiper Park Switch parameter is Active.

⇒ **If the parameter does not change**

Refer to Circuit/System Testing – Windshield Wiper Motor Malfunction.

⇓ **If the parameter changes**

8. All OK.

Circuit/System Testing

Windshield Wiper/Washer Switch Malfunction

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch. It may take up to 11 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 1 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

2.2. Test for less than 2 Ω in the low reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Windshield Wiper High Speed Switch parameter is Inactive.

⇒ **If not Inactive**

4.1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit terminal 4 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the low reference circuit terminal 1.
6. Verify the scan tool Windshield Wiper High Speed Switch parameter is Active.

⇒ **If not Active**

6.1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K9 Body Control Module, vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

7. Test for greater than 8 V between the signal circuit terminal 3 and ground.

⇒ **If less than 8 V**

7.1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

7.2. Test for infinite resistance between the signal circuit and ground

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

7.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If 8 V or greater**

8. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle in Service Mode.
9. Test for less than 1 V between the S82 Windshield Wiper/Washer Switch signal circuit terminal 3 and ground.

⇒ **If 1 V or greater**

Repair the short to voltage on the circuit.

⇓ **If less than 1 V**

10. Test or replace the S82 Windshield Wiper/Washer Switch.

Windshield Wiper Motor Malfunction

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the M75 Windshield Wiper Motor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 6 and ground:

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Windshield Wiper Park Switch parameter is Inactive.

⇒ **If not Inactive**

4.1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the M75 Windshield Wiper Motor park switch signal circuit terminal 4 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 4 and ground circuit terminal 6.
6. Verify the scan tool Windshield Wiper Park Switch parameter is Active.

⇒ **If not Active**

6.1. Vehicle OFF, remove the jumper wire, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

7. Connect a test lamp between the control circuit terminal 2 and ground, vehicle in Service Mode.
8. Verify the test lamp does NOT turn ON and OFF when commanding the Windshield Washer Relay Low and Off with a scan tool.

⇒ **If the test lamp turns ON and OFF**

Test or replace the M75 Windshield Wiper Motor.

⇓ **If the test lamp does not turn ON and OFF**

9. Connect a test lamp between the following control circuits and ground, ignition ON.
   - Windshield Wiper Motor Low Speed Control Circuit Terminal 3
   - Windshield Wiper Motor High Speed Control Circuit Terminal 2
10. Verify the test lamp does NOT turn ON and OFF when commanding the Windshield Washer Relay High and Off with a scan tool.

⇒ **If the test lamp turns ON and OFF**

Test or replace the M75 Windshield Wiper Motor.

⇓ **If the test lamp does not turn ON and OFF**

11. Vehicle OFF and all vehicle systems OFF, connect the harness connector at the M75 Windshield Wiper Motor. Disconnect the X1 harness connector at the X50A Fuse Block - Underhood. It may take up to 2 min for all vehicle systems to power down.
12. Test for less than 10 Ω between each ground circuit listed below and ground:
    - Terminal 1
    - Terminal 26

⇒ **If 10 Ω or greater**

12.1. Vehicle OFF.

12.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

13. Vehicle in Service Mode.
14. Verify the M75 Windshield Wiper Motor is not activated.

⇒ **If the M75 Windshield Wiper Motor is activated**

14.1. Vehicle OFF, disconnect the harness connector at the M75 Windshield Wiper Motor, vehicle in Service Mode.

14.2. Test for less than 1 V between each control circuit listed below and ground:
   - Terminal 2
   - Terminal 3

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the M75 Windshield Wiper Motor.

⇓ **If the M75 Windshield Wiper Motor is not activated**

15. Connect a 20 A fused jumper wire between each control circuit listed below, one at a time, and B+:
    - Terminal 24
    - Terminal 22
16. Verify the M75 Windshield Wiper Motor activates.

⇒ **If the M75 Windshield Wiper Motor does not activate**

16.1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the M75 Windshield Wiper Motor.

16.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than Infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

16.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the M75 Windshield Wiper Motor.

⇓ **If the M75 Windshield Wiper Motor activates**

17. Vehicle OFF, connect the X1 harness connector at the X50A Fuse Block – Underhood. Disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
18. Verify the M75 Windshield Wiper Motor low speed is not activated.

⇒ **If the M75 Windshield Wiper Motor low speed is activated**

18.1. Vehicle OFF, disconnect the X1 harness connector at the X50A Fuse Block – Underhood, vehicle in Service Mode.

18.2. Test for less than 1 V between the X1 harness connector at the X50A Fuse Block – Underhood control circuit terminal 16 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the X50A Fuse Block – Underhood.

⇓ **If the M75 Windshield Wiper Motor low speed is not activated**

19. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
20. Verify the M75 Windshield Wiper Motor High Speed is not activated.

⇒ **If the M75 Windshield Wiper Motor high speed is activated**

20.1. Vehicle OFF, disconnect the X1 harness connector at the X50A Fuse Block – Underhood, vehicle in Service Mode.

20.2. Test for infinite resistance between the X1 harness connector at the X50A Fuse Block – Underhood control circuit terminal 20 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the X50A Fuse Block – Underhood.

⇓ **If the M75 Windshield Wiper Motor high speed is not activated**

21. Connect a 10 A fused jumper wire between the control circuit terminal 16 X4 and B+.
22. Verify the M75 Windshield Wiper Motor activates.

⇒ **If the M75 Windshield Wiper Motor does not activate**

22.1. Vehicle OFF, remove the jumper wire, disconnect the X1 harness connector at the X50A Fuse Block – Underhood.

22.2. Test for infinite resistance between the X1 harness connector at the X50A Fuse Block – Underhood control circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If less than infinite resistance

22.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the X50A Fuse Block – Underhood.

⇓ **If the M75 Windshield Wiper Motor activates**

23. Connect a 10 A fused jumper wire between the control circuit terminal 24 X5 and ground.
24. Verify the M75 Windshield Wiper Motor activates.

⇒ **If the M75 Windshield Wiper Motor does not activate**

24.1. Vehicle OFF, remove the jumper wire, disconnect the X1 harness connector at the X50A Fuse Block – Underhood.

24.2. Test for less than 1 V between the X1 harness connector at the X50A Fuse Block – Underhood control circuit and ground.

⇒ If 1 V or greater, repair the short to ground on the circuit.

⇓ If less than 1 V

24.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the X50A Fuse Block – Underhood.

⇓ **If the M75 Windshield Wiper Motor activates**

25. Replace the K9 Body Control Module.

Component Testing

Windshield Wiper/Washer Switch

1. Vehicle OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch.
2. Test for infinite resistance between the signal terminal 4 and the low reference terminal 1 with the switch in the open position.

⇒ **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.

⇓ **If infinite resistance**

3. Test for less than 2 Ω between the signal circuit terminal 4 and the low reference circuit terminal 1 with the switch in the closed position.

⇒ **If 2 Ω or greater**

Replace the S82 Windshield Wiper/Washer Switch.

⇓ **If less than 2 Ω**

4. Test for infinite resistance between the signal terminal 3 and the low reference terminal 1 with the switch in the open position.

⇒ **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.

⇓ **If infinite resistance**

5. Verify the resistance readings are within the specified range listed below between the signal circuit terminal 3 and the low reference circuit terminal 1 by pushing the switch in the listed positions below.
   - Delay 1 : 7.50-8.00kΩ
   - Delay 2 : 1.29-1.34kΩ
   - Delay 3 : 1.95-2.00kΩ
   - Delay 4 : 2.78-2.82kΩ
   - Delay 5 :3.84-3.90kkΩ

⇒ **If not within the specified range**

Replace the S82 Windshield Wiper/Washer Switch.

⇓ **If within the specified range**

6. All OK

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Windshield Wiper Motor Replacement on page 4-332*
- *Windshield Wiper and Washer Switch Replacement on page 4-319*
- *Control Module References on page 6-3* for BCM replacement, programming and setup

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Washer Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B3873 01: Front Washer Relay Circuit Short to Battery
DTC B3873 02: Front Washer Relay Circuit Short to Ground
DTC B3873 04: Front Washer Relay Circuit Open Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Windshield Washer Switch Signal	2	1	—	—
Windshield Washer Pump Control	1	1	2	—
Windshield Washer Relay Control	B3873 02	B3873 04	B3873 01	—
Windshield Washer Pump Ground	—	1	—	—
Windshield Wiper/Washer Switch Low Reference	—	1	—	—
1. Washer Inoperative 2. Washer Always ON				

Circuit/System Description

The body control module (BCM) controls the windshield washer pump based on an input from the windshield wiper/washer switch. The BCM monitors the washer switch through the windshield washer switch signal circuit. When the washer switch is closed, low reference is supplied to the windshield washer switch signal circuit. When this is the case, the BCM will command the windshield washer pump and the low speed wipers on.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The system voltage is between 9–16 V.

Conditions for Setting the DTC

- A short to ground or an open/high resistance is detected in the windshield washer relay control circuit.
- A short to voltage is detected in the windshield washer relay control circuit.

Action Taken When the DTC Sets

Washer operation is suspended.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Reference Information

Schematic Reference

Wiper/Washer Schematics on page 4-287

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Wiper/Washer System Description and Operation on page 4-336

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC B1517 is set in the K9 Body Control Module.

⇒ **If the DTC B1517 is set**

Refer to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92*.

⇓ **If the DTC B1517 is not set**

3. Verify the scan tool Windshield Washer Switch parameter changes between Active and Inactive when pressing the windshield washer switch.

⇒ **If the parameter does not change**

Refer to Circuit/System Testing – Windshield Wiper/Washer Switch Malfunction.

⇓ **If the parameter changes**

4. Verify the windshield washers turn On when commanding the Windshield Washer Relay Active with a scan tool.

⇒ **If the Windshield Washers do not turn ON**

Refer to Circuit/System Testing – Windshield Washer Pump Malfunction

⇓ **If the Windshield Washers turn ON**

5. All OK.

Circuit/System Testing

Windshield Wiper/Washer Switch Malfunction

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch. It may take up to 11 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 1 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the low reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Windshield Washer Switch parameter is Inactive.

⇒ **If not Inactive**

4.1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit terminal 8 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 8 and the low reference circuit terminal 1.

6. Verify the scan tool Windshield Washer Switch parameter is Active.

⇒ **If not Active**

6.1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K9 Body Control Module, vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

7. Test or replace the S82 Windshield Wiper/Washer Switch.

Windshield Washer Pump Malfunction

1. Vehicle OFF, and all vehicle systems OFF. Disconnect the harness connector at the G24 Windshield Washer Pump. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.

⇒ **If 10 Ω or greater**

2.1. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Connect a test lamp between the control circuit terminal 1 and the ground circuit terminal 2, vehicle in Service Mode.
4. Verify the test lamp does NOT turn ON and OFF when commanding the Windshield Washer Relay Active and Inactive with a scan tool.

⇒ **If the test lamp turns ON and OFF**

Test or replace the G24 Windshield Washer Pump.

⇓ **If the test lamp does not turn ON and OFF**

5. Vehicle OFF, connect the harness connector at the G24 Windshield Washer Pump. Disconnect the X1 harness connector at the X50A Fuse Block – Underhood, It may take up to 2 min for all vehicle systems to power down.
6. Test for less than 10 Ω between the ground circuit terminal 26 and ground.

⇒ **If 10 Ω or greater**

6.1. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

7. Vehicle OFF, connect the X1 harness connector at the X50A Fuse Block - Underhood and disconnect the X2 harness connector at the X50A Fuse Block - Underhood, vehicle in Service Mode..
8. Verify the G24 Windshield Washer Pump is not activated.

⇒ **If the G24 Windshield Washer Pump is activated**

8.1. Vehicle OFF, disconnect the harness connector at the G24 Windshield Washer Pump, vehicle in Service Mode.

8.2. Test for less than 1 V between the control circuit terminal 1 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the G24 Windshield Washer Pump.

⇓ **If the G24 Windshield Washer Pump is not activated**

9. Connect a 20 A fused jumper wire between the control circuit terminal 26 and B+.
10. Verify the G24 Windshield Washer Pump activates.

⇒ **If the G24 Windshield Washer Pump does not activate**

10.1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the G24 Windshield Washer Pump, vehicle in Service Mode.

10.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than Infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

10.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the G24 Windshield Washer Pump.

⇓ **If the G24 Windshield Washer Pump activates**

11. Vehicle OFF, connect the X2 harness connector at the X50A Fuse Block – Underhood. Disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.

12. Verify the G24 Windshield Washer Pump is not activated.

⇒ **If the G24 Windshield Washer Pump is activated**

12.1. Vehicle OFF, disconnect the X1 harness connector at the X50A Fuse Block – Underhood, vehicle in Service Mode.

12.2. Test for less than 1 V between the control circuit terminal 15 and B+.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the X50A Fuse Block – Underhood.

⇓ **If the G24 Windshield Washer Pump is not activated**

13. Connect a 10 A fused jumper wire between the control circuit terminal 14 and B+.
14. Verify the G24 Windshield Washer Pump activates.

⇒ **If the G24 Windshield Washer Pump does not activate**

14.1. Vehicle OFF, remove the jumper wire, disconnect the X1 harness connector at the X50A Fuse Block – Underhood.

14.2. Test for infinite resistance between the control circuit terminal 15 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If less than infinite resistance

14.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the X50A Fuse Block – Underhood.

⇓ **If the G24 Windshield Washer Pump activates**

15. Replace the K9 Body Control Module.

Component Testing

Windshield Wiper/Washer Switch

1. Vehicle OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch.
2. Test for infinite resistance between the signal terminal 8 and the low reference terminal 1 with the switch in the open position.

⇒ **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.

⇓ **If infinite resistance**

3. Test for less than 2 Ω between the signal circuit terminal 8 and the low reference circuit terminal 1 with the switch in the closed position.

⇒ **If 2 Ω or greater**

Replace the S82 Windshield Wiper/Washer Switch.

⇓ **If less than 2 Ω**

4. All OK

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Windshield Washer Pump Replacement on page 4-325*
- *Relay Replacement (Within an Electrical Center) on page 11-953* or *Relay Replacement (Attached to Wire Harness) on page 11-953*
- *Windshield Wiper and Washer Switch Replacement on page 4-319*
- *Control Module References on page 6-3* for BCM replacement, programming, and setup.

Rear Wiper System Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptor

DTC B370B 02: Rear Wiper Function Control Circuit Short to Ground
DTC B370B 01: Rear Wiper Function Control Circuit Short to Voltage
DTC B370B 04: Rear Wiper Function Control Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Rear Wiper Switch Signal	2	1	1	—
Rear Wiper Motor Control	1	1	2	—
Rear Window Wiper Relay Control	B370B 02	B370B 04	B370B 01	—
Rear Wiper Relay Control	1	1	2	—
Rear Wiper Motor Ground	—	1	1	—
Rear Wiper Relay Ground	—	1	—	—
1. Rear Wiper Inoperative. 2. Rear Wiper Always ON.				

Circuit/System Description

The body control module (BCM) controls the single speed rear wiper motor by its active high output to the external rear wiper motor relay. When the BCM activates its output and applies battery to the coil of the relay, the relay energizes, allowing battery voltage from the fuse to be applied through the switched contacts of the rear wiper motor relay to the control input of the rear wiper motor . The motor then operates continuously at low speed.

Conditions for Running the DTC

- Vehicle in Service Mode
- The system voltage is between 9–16 V.

Conditions for Setting the DTC

A short to ground or an open/high resistance is detected in the rear window wiper control circuit.

Action Taken When the DTC Sets

Rear wiper operation is suspended.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Reference Information

Schematic Reference

Wiper/Washer Schematics on page 4-287

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Wiper/Washer System Description and Operation on page 4-336

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC B1517 is set in the K9 Body Control Module.

⇒ **If the DTC B1517 is set**

Refer to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92*.

⇓ **If the DTC B1517 is not set**

3. Verify the scan tool Rear Wiper Switch parameter changes between Off and On when turning the rear wipers ON and OFF..

⇒ **If the parameter does not change**

Refer to Circuit/System Testing – Rear Wiper/ Washer Switch Malfunction.

⇓ **If the parameter changes**

4. Verify the Rear Wiper Motor turns On when commanding the Rear Wiper Active with a scan tool.

⇒ **If the Rear Wiper Motor does not turn ON**

Refer to Circuit/System Testing – Rear Wiper Motor Malfunction

⇓ **If the Rear Wiper Motor turns ON**

5. All OK.

Circuit/System Testing

Rear Wiper/Washer Switch Malfunction

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch. It may take up to 11 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 1 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the low reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Test for greater than 8 V between the signal circuit terminal 7 and ground.

⇒ **If less than 8 V**

4.1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit and ground

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

4.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If 8 V or greater**

5. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
6. Test for less than 1 V between the S82 Windshield Wiper/Washer Switch signal circuit terminal 7 and ground.

⇒ **If 1 V or greater**

Repair the short to voltage on the circuit.

⇓ **If less than 1 V**

7. Test or replace the S82 Windshield Wiper/Washer Switch.

Rear Wiper Motor Malfunction

1. Vehicle OFF, and all vehicle systems OFF. Disconnect the harness connector at the M45 Rear Wiper Motor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.

⇒ **If 10 Ω or greater**

2.1. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 3 and the ground circuit terminal 1.

⇒ **If the test lamp does not illuminate**

4.1. Vehicle OFF, remove the test lamp. Disconnect the X2 harness connector at the X50A Fuse Block – Underhood.

4.2. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the X50A Fuse Block – Underhood.

⇓ **If the test lamp illuminates**

5. Connect a test lamp between the control circuit terminal 2 and the ground circuit terminal 1.
6. Verify the test lamp does NOT turn ON and OFF when commanding the Rear Wiper On and Off with a scan tool.

⇒ **If the test lamp turns ON and OFF**

Test or replace the M45 Rear Wiper Motor.

⇓ **If the test lamp does not turn ON and OFF**

7. Vehicle OFF, connect the harness connector at the M45 Rear Wiper Motor. Disconnect the X2 harness connector at the X50A Fuse Block – Underhood, It may take up to 2 min for all vehicle systems to power down.
8. Test for less than 10 Ω between each ground circuit listed below and ground:
   - Terminal 39
   - Terminal 44

⇒ **If 10 Ω or greater**

8.1. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

9. Vehicle in Service Mode.
10. Verify the M45 Rear Wiper Motor is not activated.

⇒ **If the M45 Rear Wiper Motor is activated**

10.1. Vehicle OFF, disconnect the harness connector at the M45 Rear Wiper Motor, vehicle in Service Mode.

10.2. Test for less than 1 V between the control circuit terminal 2 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the M45 Rear Wiper Motor.

⇓ **If the M45 Rear Wiper Motor is not activated**

11. Connect a 20 A fused jumper wire between both of the circuits listed below and B+:
    - B+ Circuit Terminal 29
    - Control Circuit Terminal 37

12. Verify the M45 Rear Wiper Motor activates.

⇒ **If the M45 Rear Wiper Motor does not activate**

12.1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the M45 Rear Wiper Motor, vehicle in Service Mode.

12.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than Infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

12.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the M45 Rear Wiper Motor.

⇓ **If the M45 Rear Wiper Motor activates**

13. Vehicle OFF, connect the X2 harness connector at the X50A Fuse Block – Underhood. Disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
14. Verify the M45 Rear Wiper Motor is not activated.

⇒ **If the M45 Rear Wiper Motor is activated**

14.1. Vehicle OFF, disconnect the X2 harness connector at the X50A Fuse Block – Underhood, vehicle in Service Mode.

14.2. Test for less than 1 V between the control circuit terminal 35 and B+.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the X50A Fuse Block – Underhood.

⇓ **If the M45 Rear Wiper Motor is not activated**

15. Connect a 10 A fused jumper wire between the control circuit terminal 10 and B+.
16. Verify the M45 Rear Wiper Motor activates.

⇒ **If the M45 Rear Wiper Motor does not activate**

16.1. Vehicle OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block – Underhood.

16.2. Test for infinite resistance between the control circuit terminal 27 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If less than infinite resistance

16.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the X50A Fuse Block – Underhood.

⇓ **If the M45 Rear Wiper Motor activates**

17. Test or replace the K9 Body Control Module.

Component Testing

Windshield Wiper/Washer Switch

1. Vehicle OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch.
2. Test for infinite resistance between the signal terminal 7 and the low reference terminal 1 with the rear window washer switch in the open position.

⇒ **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.

⇓ **If infinite resistance**

3. Verify the resistance reading is within the range specified below between the signal circuit terminal 7 and the low reference circuit terminal 1 by cycling the switch between Rear Wiper position and Rear Washers position.
   - Rear Wiper : 624-644Ω
   - Rear Wiper Sweep : 1.99-2.01kΩ
   - Rear Washer : 6.11-6.13kΩ

⇒ **If not within range specified**

Replace the S82 Windshield Wiper/Washer Switch.

⇓ **If within range specified**

4. All OK

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Rear Window Wiper Motor Replacement on page 4-333*
- *Windshield Wiper and Washer Switch Replacement on page 4-319*
- *Control Module References on page 6-3* or BCM replacement, programming and setup

Rear Washer System Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptor

DTC B3811 02: Rear Washer Relay Circuit Short to Ground
DTC B3811 01: Rear Washer Relay Circuit Short to Voltage
DTC B3811 04: Rear Washer Relay Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Rear Washer Switch Control	2	3	3	—
Rear Washer Relay Control	B3811 02	B3811 04	B3811 01	—
Rear Washer Pump Control	1	1	2	—
Rear WasherPump Ground	—	1	1, 2	—

1. Rear Washer Inoperative.
2. Rear Washer Always ON.
3. Rear Wipers and Washers Inoperative.

Circuit/System Description

When the body control module (BCM) detects that the rear wiper/wash switch has activated the momentary Wash switch, it activates a high side drive output which supplies battery to the coil of the rear washer pump relay. This energizes the relay, which switches battery power to the washer pump motor. The BCM will also activate continuous low speed windshield wipers as described above. This Washer and Wiper operation shall be continued so long as the switch remains active. Upon termination, the rear wash motor will be deactivated and the wiper shall move to its park position and deactivate.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The system voltage is between 9–16 V.

Conditions for Setting the DTC

A short to ground, short to voltage, or an open/high resistance is detected in the rear washer relay control circuit.

Action Taken When the DTC Sets

Washer operation is suspended.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- A history DTC will clear after 50 consecutive ignition cycles without a fault present.

Reference Information

Schematic Reference

Wiper/Washer Schematics on page 4-287

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Wiper/Washer System Description and Operation on page 4-336

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Rear Wiper Switch parameter changes between Off and On when pressing the windshield washer switch.

⇒ **If the parameter does not change**

Refer to *Rear Wiper System Malfunction on page 4-312*

⇓ **If the parameter changes**

3. Verify the rear window washers turn On when commanding the Rear Washer Relay Active with a scan tool.

⇒ **If the Rear Window Washers do not turn ON**

Refer to Circuit/System Testing

⇓ **If the Rear Window Washers turn ON**

4. All OK.

Circuit/System Testing

1. Vehicle OFF, and all vehicle systems OFF. Disconnect the harness connector at the G19 Rear Window Washer Pump. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.

⇒ **If 10 Ω or greater**

2.1. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Connect a test lamp between the control circuit terminal 1 and the ground circuit terminal 2, vehicle in Service Mode.
4. Verify the test lamp does NOT turn ON and OFF when commanding the Rear Washer Relay Active and Inactive with a scan tool.

⇒ **If the test lamp turns ON and OFF**

Test or replace the G19 Rear Window Washer Pump.

⇓ **If the test lamp does not turn ON and OFF**

5. Vehicle OFF, connect the harness connector at the G19 Rear Window Washer Pump. Disconnect the X2 harness connector at the X50A Fuse Block – Underhood, It may take up to 2 min for all vehicle systems to power down.
6. Test for less than 10 Ω between the ground circuit terminal 39 and ground.

⇒ **If 10 Ω or greater**

6.1. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

7. Vehicle OFF, connect the X2 harness connector at the X50A Fuse Block – Underhood. Disconnect the X1 harness connector at the X50A Fuse Block – Underhood, vehicle in Service Mode.
8. Verify the G19 Rear Window Washer Pump is not activated.

⇒ **If the G19 Rear Window Washer Pump is activated**

8.1. Vehicle OFF, disconnect the harness connector at the G19 Rear Window Washer Pump, vehicle in Service Mode.

8.2. Test for less than 1 V between the control circuit terminal 1 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the G19 Rear Window Washer Pump.

⇓ **If the G19 Rear Window Washer Pump is not activated**

9. Connect a 20 A fused jumper wire between the control circuit terminal 14 and B+.
10. Verify the G19 Rear Window Washer Pump activates.

⇒ **If the G19 Rear Window Washer Pump does not activate**

10.1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the G19 Rear Window Washer Pump, vehicle in Service Mode.

10.2. Test for infinite resistance between the control circuit and ground.

⇒ If less than Infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

10.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the G19 Rear Window Washer Pump.

⇓ **If the G19 Rear Window Washer Pump activates**

11. Vehicle OFF, connect the X1 harness connector at the X50A Fuse Block – Underhood. Disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
12. Verify the G19 Rear Window Washer Pump is not activated.

⇒ **If the G19 Rear Window Washer Pump is activated**

12.1. Vehicle OFF, disconnect the X2 harness connector at the X50A Fuse Block – Underhood, vehicle in Service Mode.

12.2. Test for less than 1 V between the control circuit terminal 4 and B+.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the X50A Fuse Block – Underhood.

⇓ **If the G19 Rear Window Washer Pump is not activated**

13. Connect a 10 A fused jumper wire between the control circuit terminal 6 and B+.
14. Verify the G19 Rear Window Washer Pump activates.

⇒ **If the G19 Rear Window Washer Pump does not activate**

14.1. Vehicle OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block – Underhood.

14.2. Test for infinite resistance between the control circuit terminal 4 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If less than infinite resistance

14.3. Test for less than 2 Ω in the control circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the X50A Fuse Block – Underhood.

⇓ **If the G19 Rear Window Washer Pump activates**

15. Replace the K9 Body Control Module.

Component Testing

Windshield Wiper/Washer Switch

1. Vehicle OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch.
2. Test for infinite resistance between the signal terminal 7 and the low reference terminal 1 with the rear window washer switch in the open position.

⇒ **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.

⇓ **If infinite resistance**

3. Verify the resistance reading is within the range specified below between the signal circuit terminal 7 and the low reference circuit terminal 2 by cycling the switch between Rear Wiper position and Rear Washers position.
   - Rear Wiper : 624-644Ω
   - Rear Wiper Sweep : 1.99-2.01kΩ
   - Rear Washer : 6.11-6.13kΩ

⇒ **If not within range specified**

Replace the S82 Windshield Wiper/Washer Switch.

⇓ **If within range specified**

4. All OK

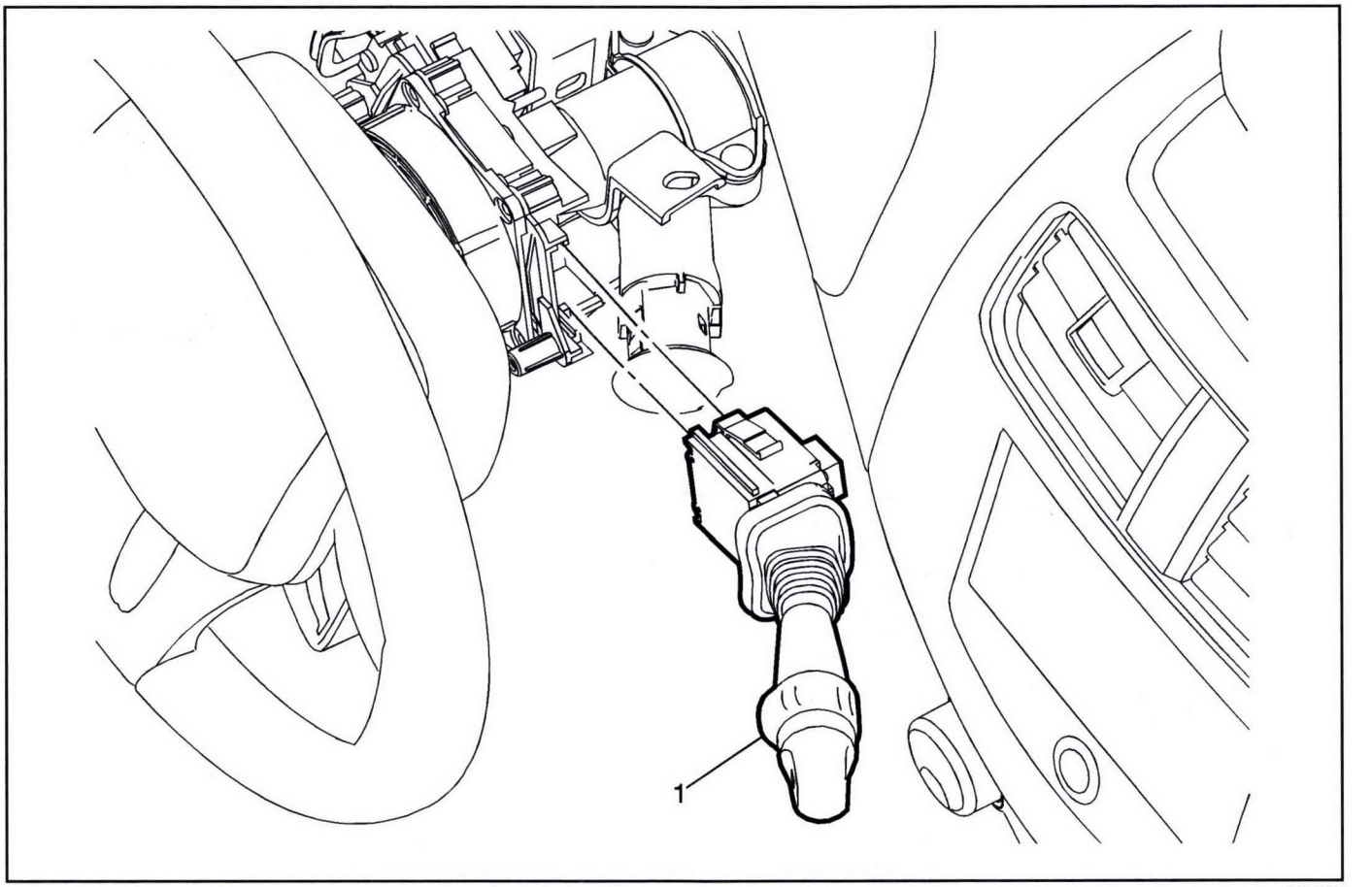
Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Relay Replacement (Within an Electrical Center) on page 11-953* or *Relay Replacement (Attached to Wire Harness) on page 11-953*
- *Windshield Washer Pump Replacement on page 4-325*
- *Windshield Wiper and Washer Switch Replacement on page 4-319*
- *Control Module References on page 6-3* for BCM replacement, programming and setup

Repair Instructions

Windshield Wiper and Washer Switch Replacement



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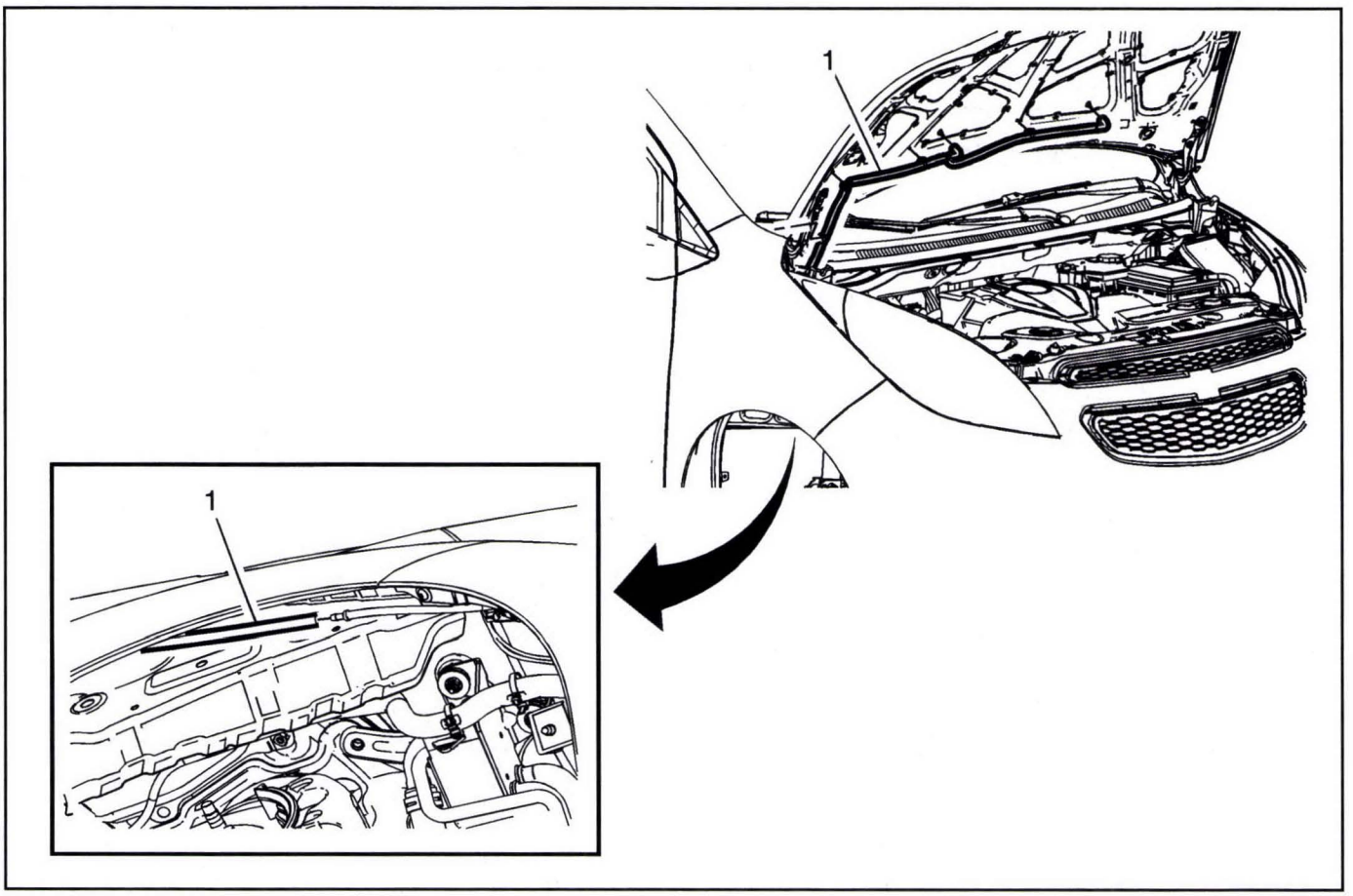
Windshield Wiper and Washer Switch Replacement

Callout	Component Name
Preliminary Procedure Remove the steering column upper trim cover. Refer to *Steering Column Upper Trim Cover Replacement on page 14-29*.	
1	Windshield Wiper and Washer Switch **Procedure** 1. Disconnect any electrical connectors. 2. Release the retaining tabs and remove the windshield wiper and washer switch from the steering column.

Windshield Washer Nozzle Hose Replacement

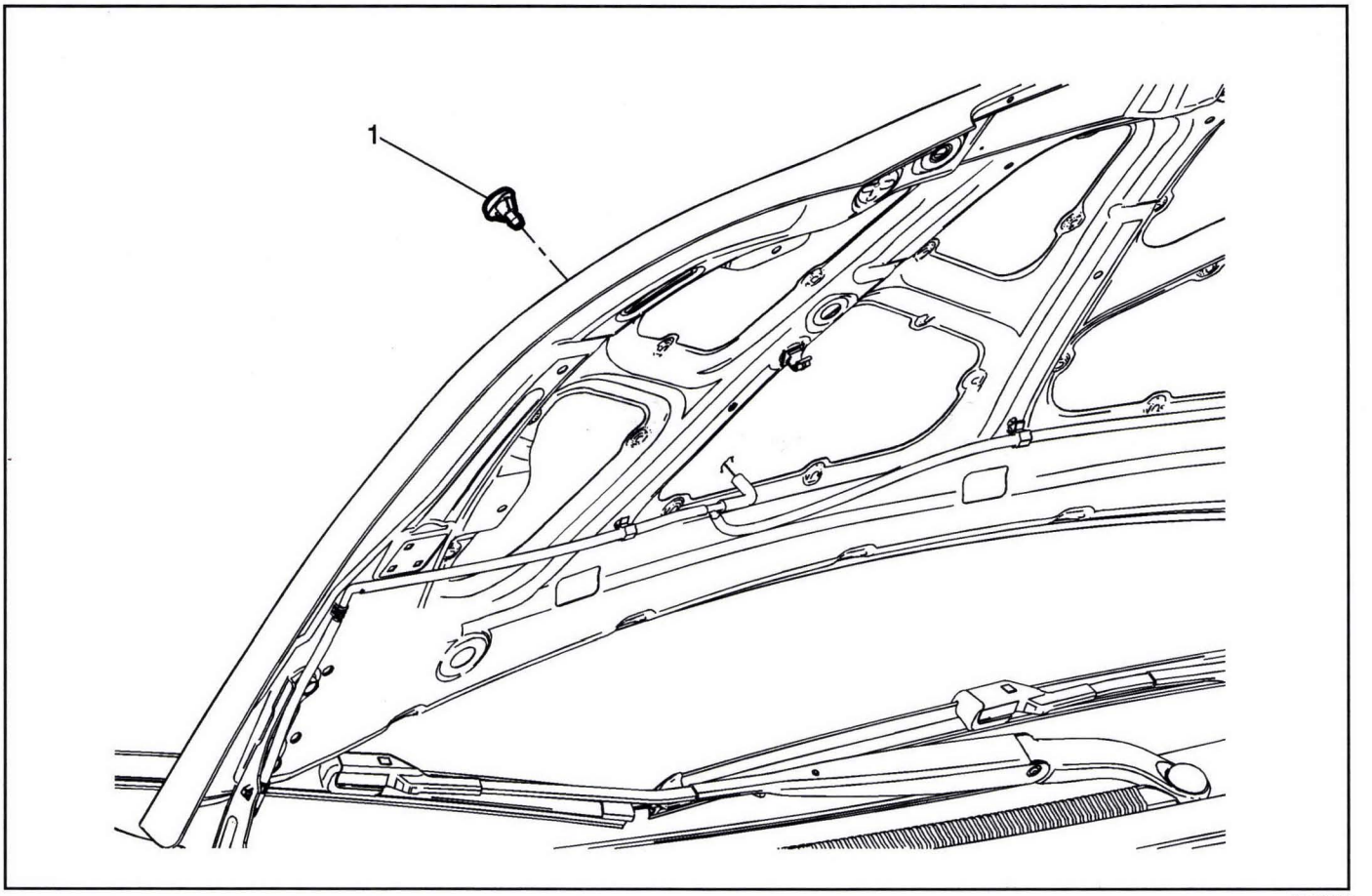


3213124

Windshield Washer Nozzle Hose Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the hood insulator. Refer to *Hood Insulator Replacement on page 3-32*. 2. Remove the front wheelhouse liner — right side. Refer to *Front Wheelhouse Liner Replacement - Right Side on page 3-138*.	
1	Windshield Washer Nozzle Hose **Procedure** 1. Disconnect windshield washer nozzle hose from above the windshield washer solvent container at the hose connector. 2. Gently pull the windshield washer nozzle hose through from the engine compartment.

Windshield Washer Nozzle Replacement

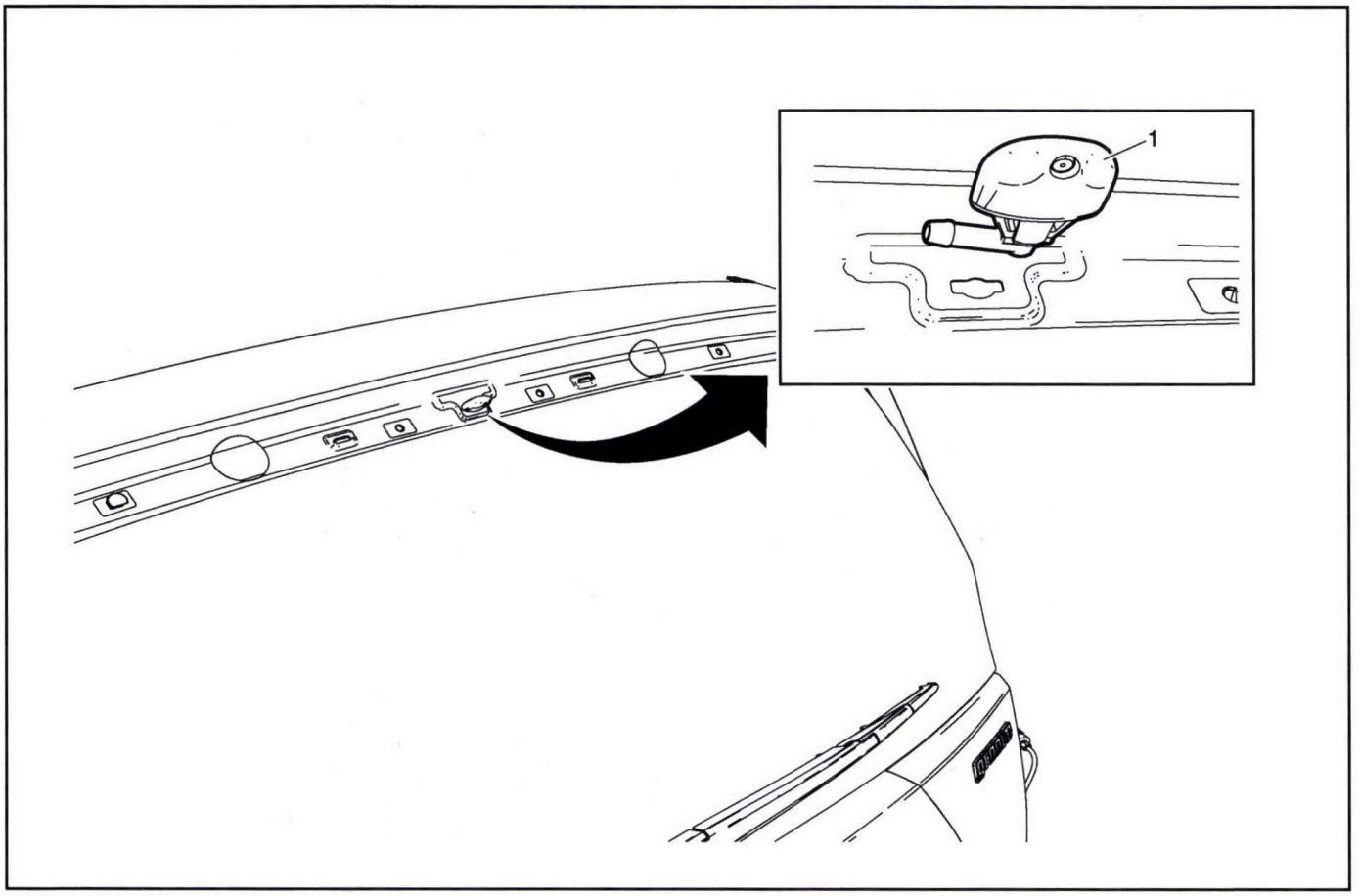


3213128

Windshield Washer Nozzle Replacement

Callout	Component Name
Preliminary Procedure Remove the hood insulator. Refer to *Hood Insulator Replacement on page 3-32*.	
1	Windshield Washer Nozzle **Procedure** 1. Disconnect windshield washer nozzle hose. 2. Pinch the windshield washer nozzle retaining tabs and push the windshield washer nozzle through the hood.

Rear Window Washer Nozzle Replacement



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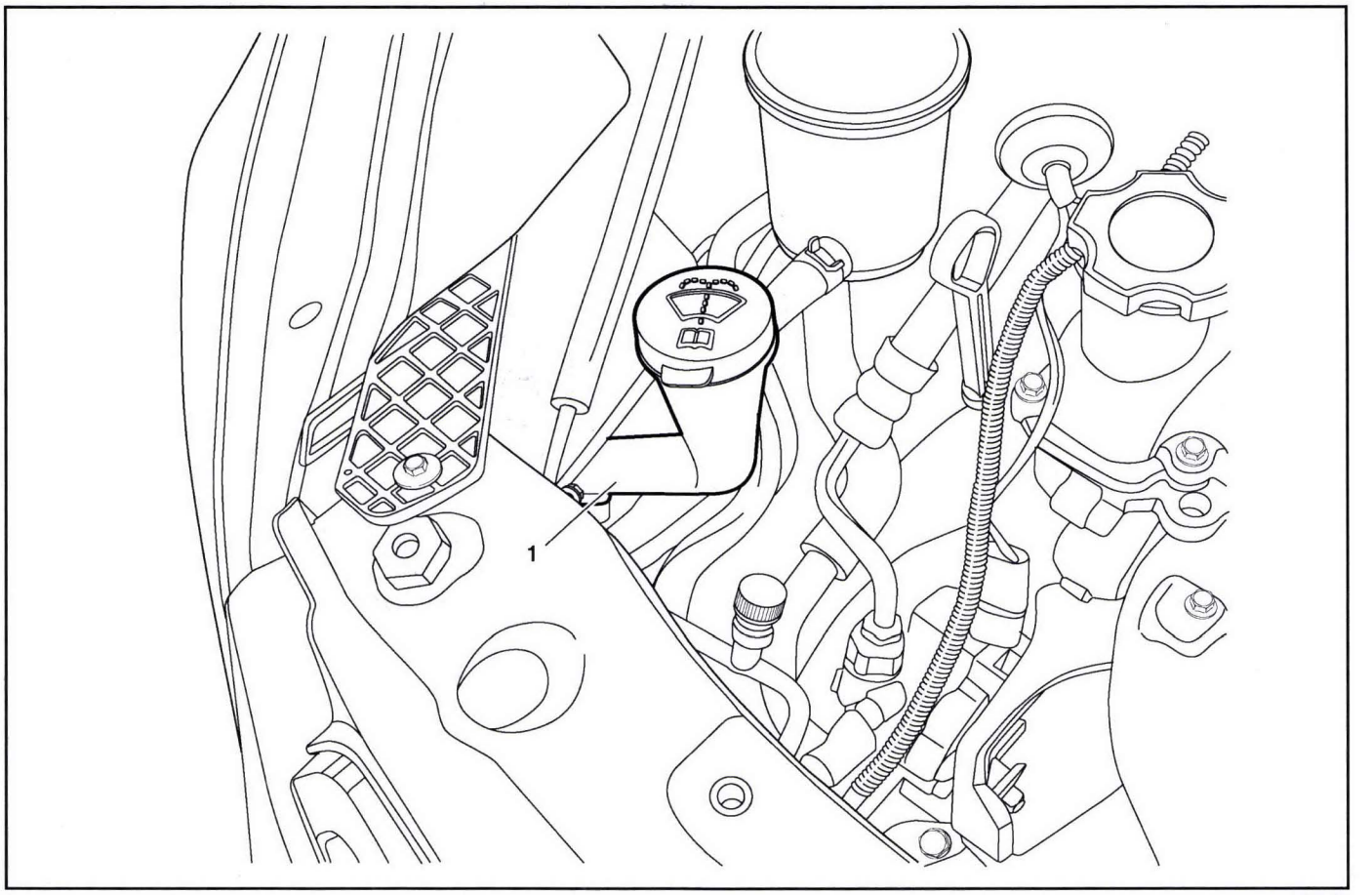
Rear Window Washer Nozzle Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the rear end spoiler. Refer to *Rear End Spoiler Replacement on page 2-17*. 2. Remove the high mount stop lamp opening cover.	
1	Rear Window Washer Nozzle **Procedure** 1. Disconnect rear window washer nozzle hose. 2. Pinch the retaining tabs and push the rear window washer nozzle through the liftgate.

Windshield Washer Solvent Container Filler Tube Replacement



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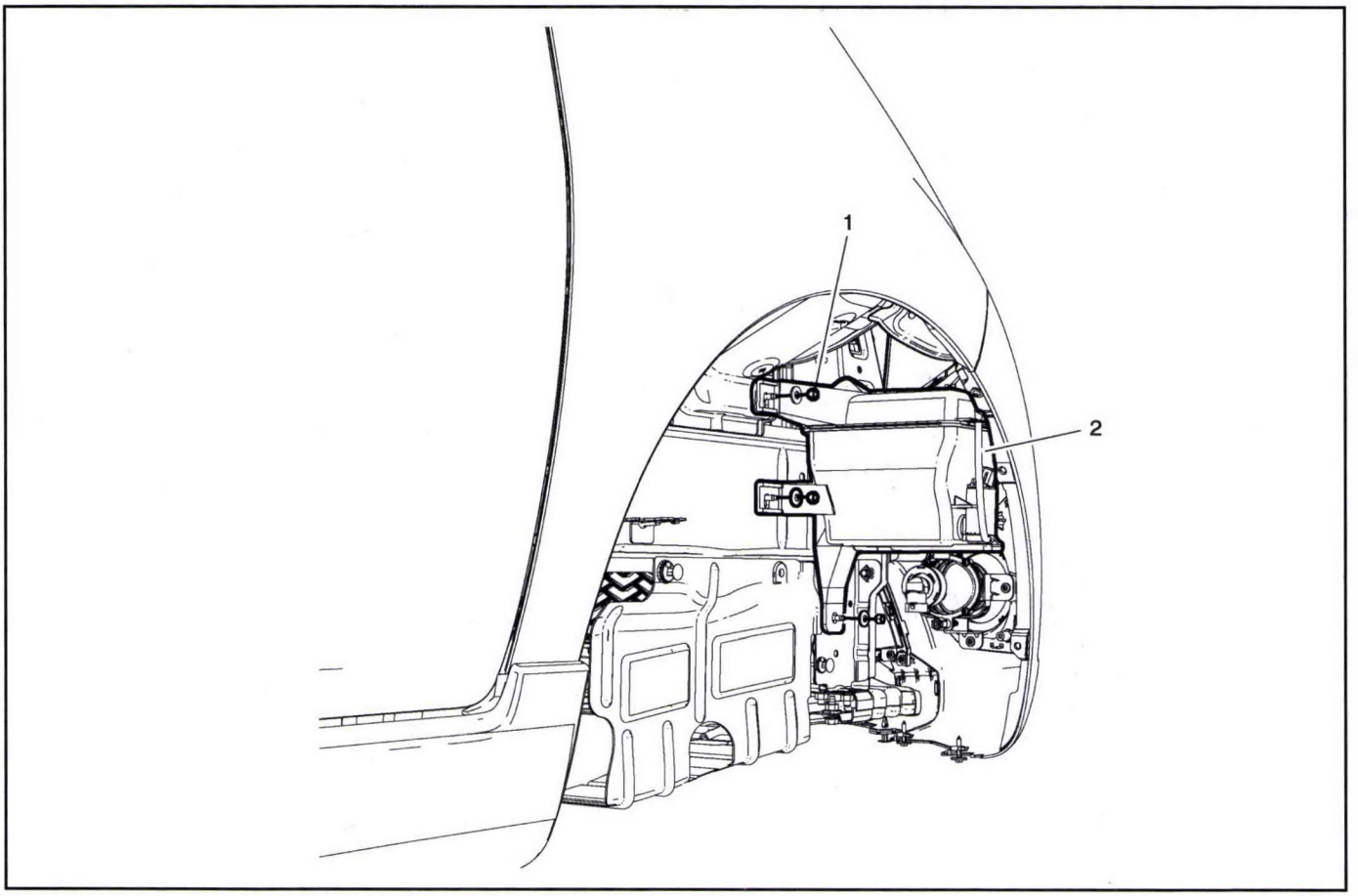
Windshield Washer Solvent Container Filler Tube Replacement

Callout	Component Name
Preliminary Procedure Remove the front compartment front sight shield. Refer to *Front Compartment Front Sight Shield Replacement on page 3-39*.	
1	Windshield Washer Solvent Container Filler Tube **Procedure** 1. Firmly pull the windshield washer solvent container filler tube from the windshield washer solvent container. 2. Inspect the grommet and replace if damaged.

Windshield Washer Solvent Container Replacement



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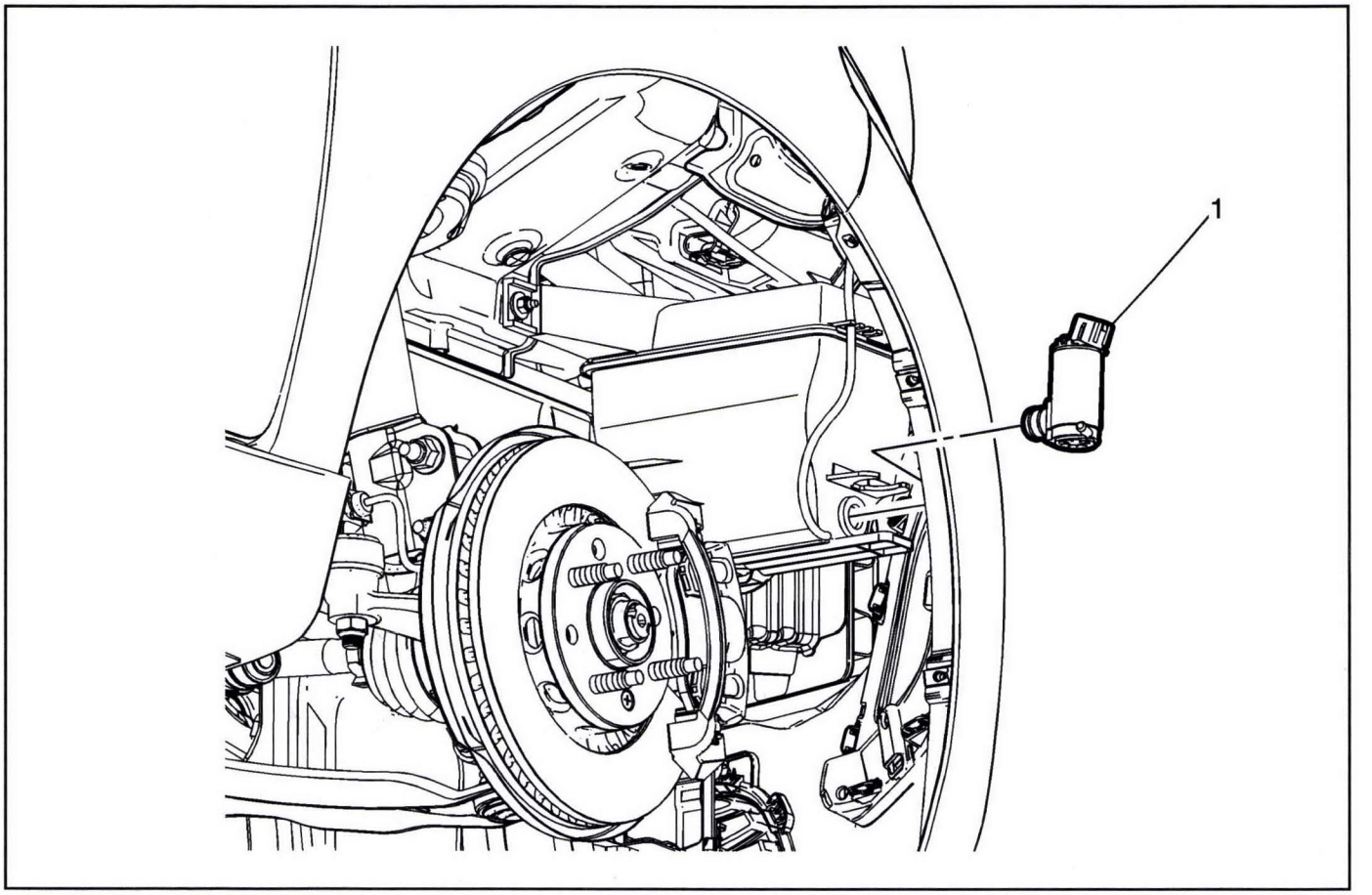
Windshield Washer Solvent Container Replacement

Callout	Component Name
Preliminary Procedure 1. Remove the front wheelhouse liner-right side. Refer to *Front Wheelhouse Liner Replacement - Right Side on page 3-138*. 2. Remove the windshield washer solvent container filler tube. Refer to *Windshield Washer Solvent Container Filler Tube Replacement on page 4-323*.	
1	Windshield Washer Solvent Container Nut (Qty: 3) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 9 N•m (80 lb in)
2	Windshield Washer Solvent Container **Procedure** 1. Place a clean suitable drain pan under the windshield washer solvent container to recover the solvent when the windshield washer hose is disconnected. 2. Disconnect the electrical connectors from the washer pumps. 3. Remove the windshield washer solvent container from the vehicle. 4. Empty the windshield washer solvent into a suitable clean container. 5. Transfer parts as needed.

Windshield Washer Pump Replacement

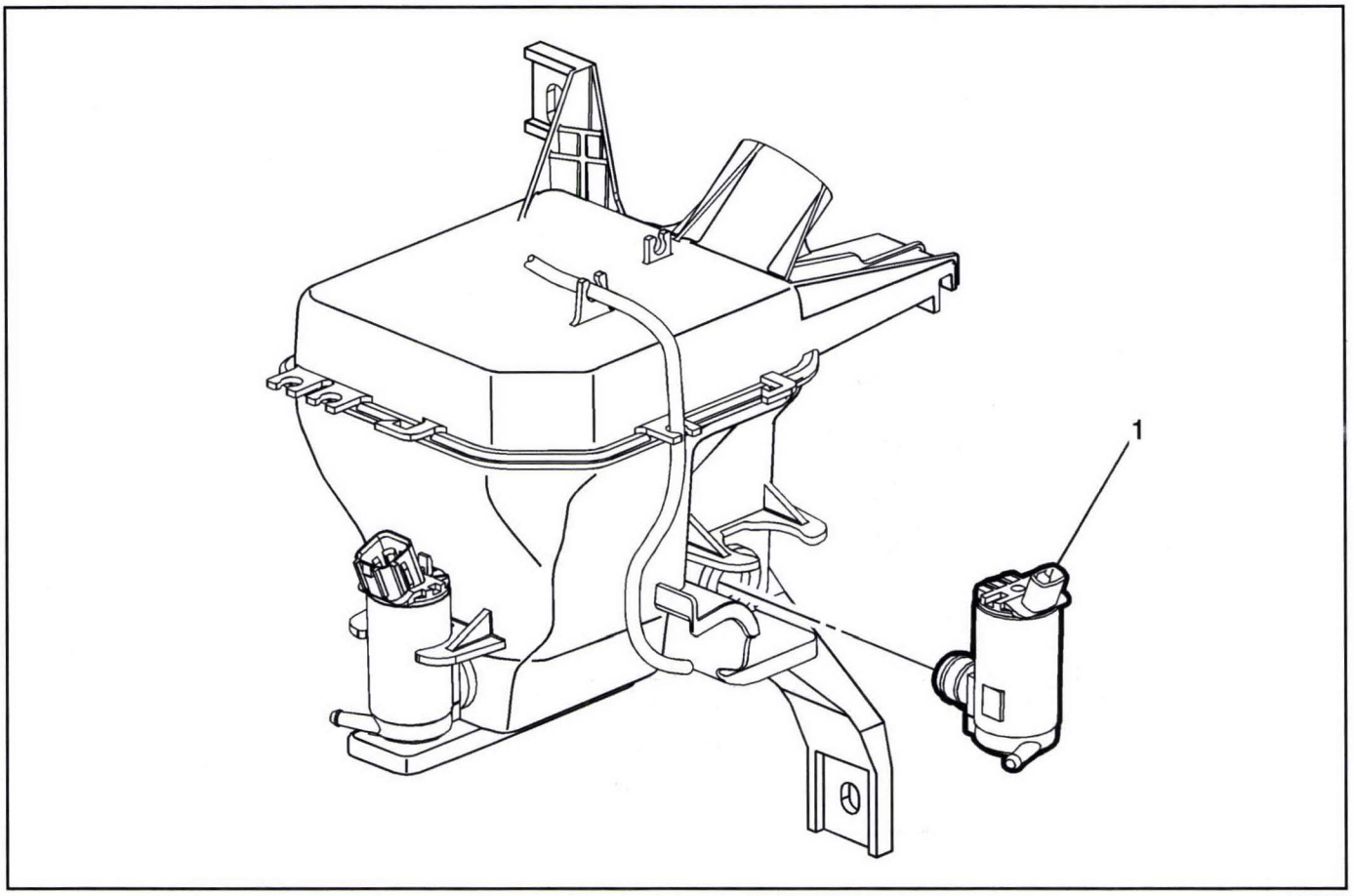


3213134

Windshield Washer Pump Replacement

Callout	Component Name
Preliminary Procedure Remove the front wheelhouse liner-right side. Refer to *Front Wheelhouse Liner Replacement - Right Side on page 3-138*.	
1	Windshield Washer Solvent Container **Procedure** 1. Place a clean suitable drain pan under the windshield washer solvent container to recover the solvent when the windshield washer hose is disconnected. 2. Disconnect the electrical connector from the windshield washer pump. 3. Firmly pull windshield washer pump outward from windshield washer solvent container. Use a plastic flat-bladed tool to assist in the removal.

Rear Window Washer Pump Replacement



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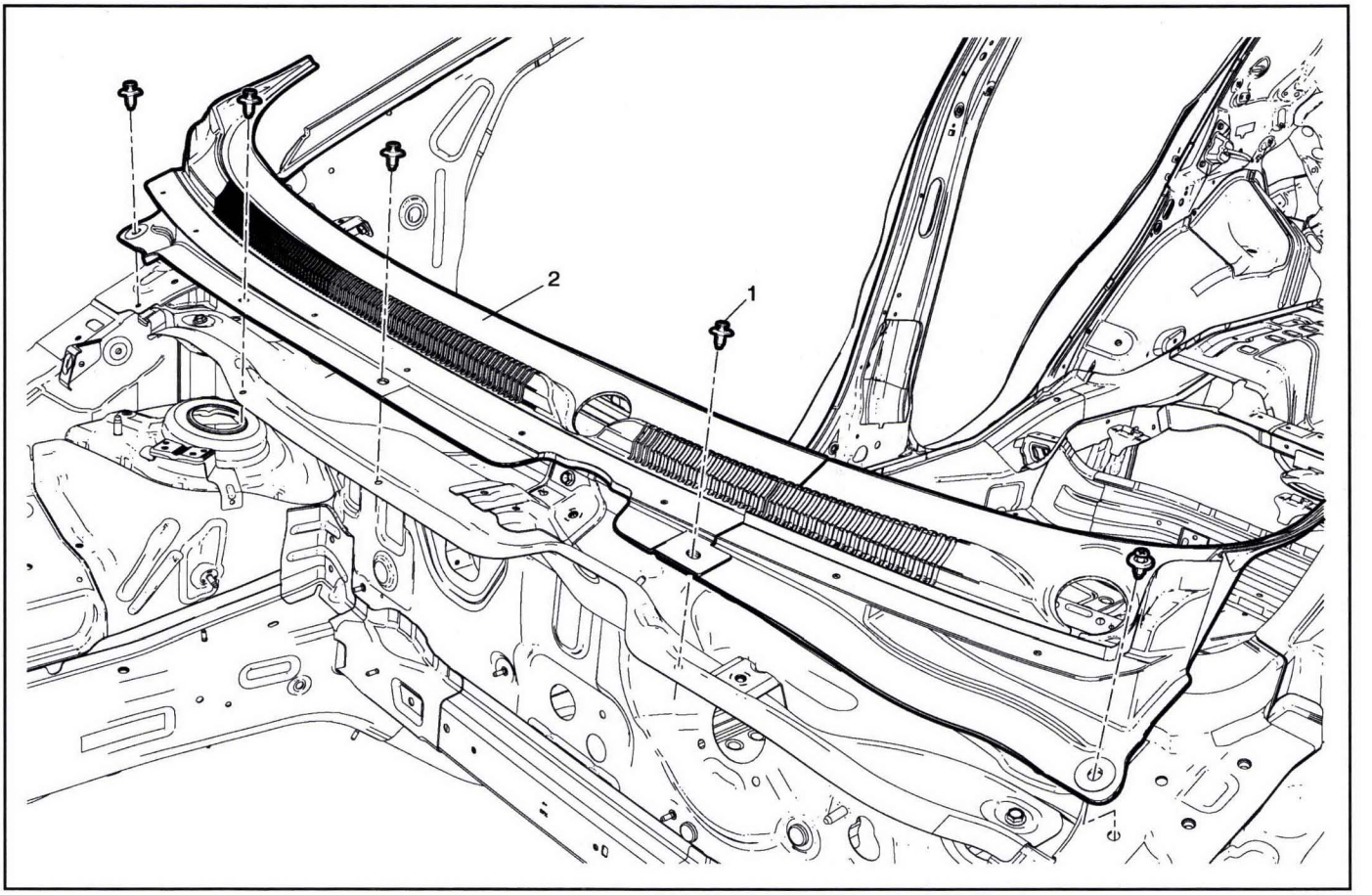
Rear Window Washer Pump Replacement

Callout	Component Name
Preliminary Procedure Remove the windshield washer solvent container. Refer to *Windshield Washer Solvent Container Replacement on page 4-324*.	
1	Rear Window Washer Pump **Procedure** Firmly pull rear window washer pump outward from windshield washer solvent container. Use a plastic flat-bladed tool to assist in the removal.

Air Inlet Grille Panel Replacement

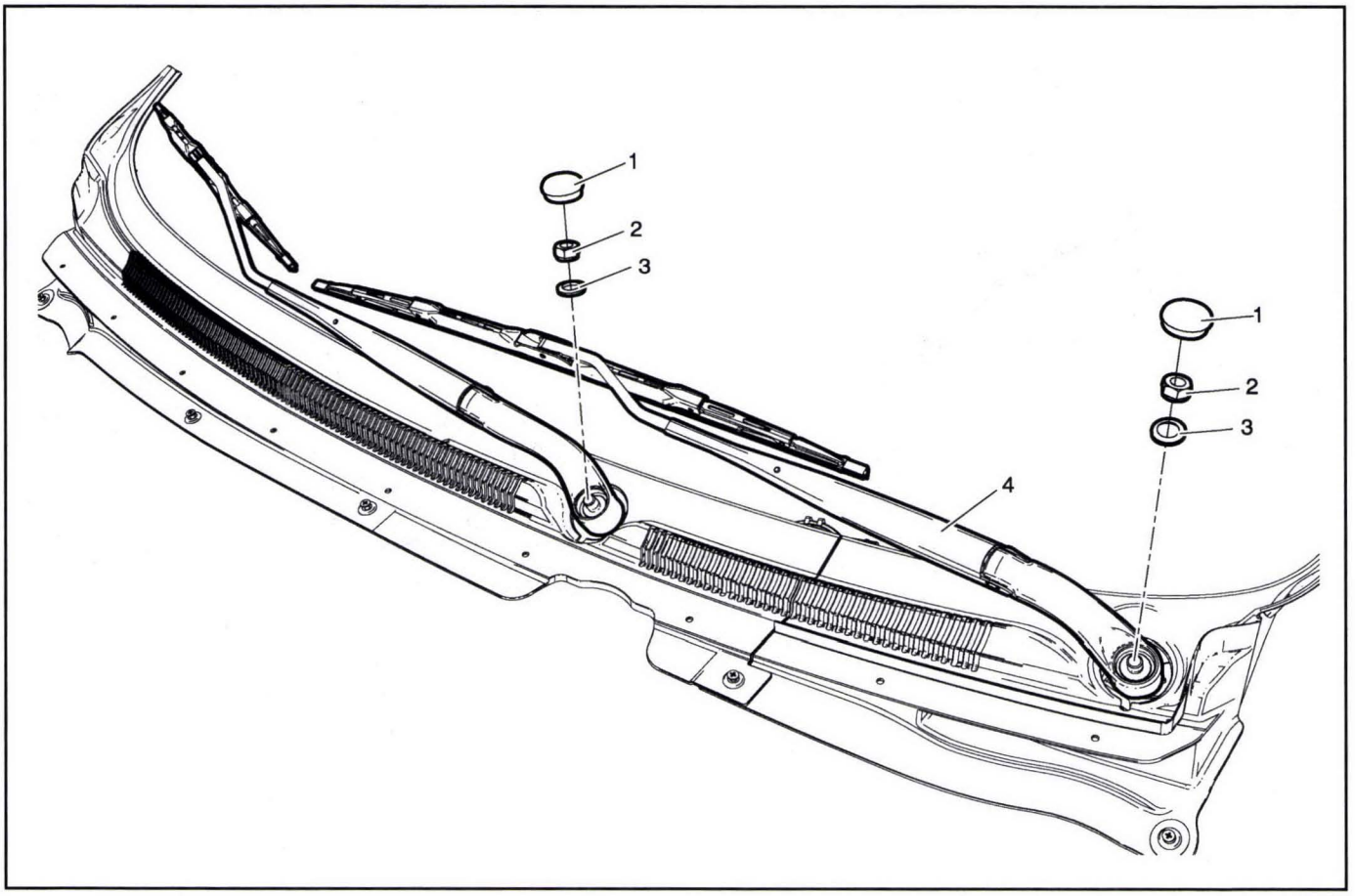


2309171

Air Inlet Grille Panel Replacement

Callout	Component Name
Preliminary Procedure Remove the wiper arms. Refer to *Windshield Wiper Arm Replacement on page 4-328*.	
1	Air Inlet Grille Panel Clip (Qty: 5)
2	Air Inlet Grille Panel **Procedure** 1. Remove hood rear weatherstrip. 2. Disengage the retaining tabs at each end of the air inlet grille panel as it attaches to the fenders.

Windshield Wiper Arm Replacement

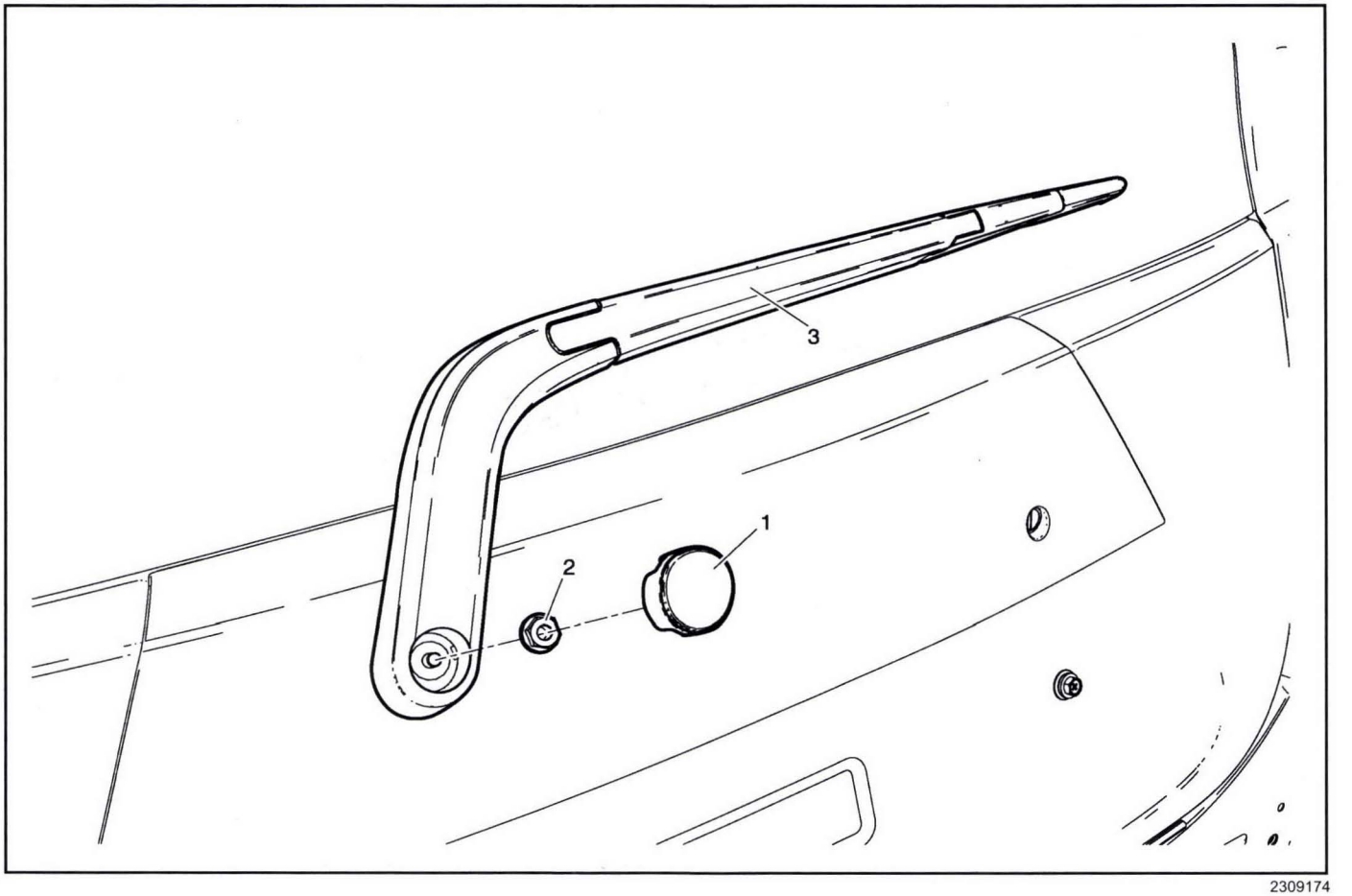


2309173

Windshield Wiper Arm Replacement

Callout	Component Name
1	Windshield Wiper Arm Finish Cap **Procedure** Use a small-flat bladed tool to remove windshield wiper arm finish cap.
2	Windshield Wiper Arm Nut (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 24 N•m (18 lb in)
3	Windshield Wiper Arm Washer (Qty: 2)
4	Windshield Wiper Arm **Procedure** **Note:** Use a windshield wiper arm puller if the arm fails to release from the wiper motor pivot shaft.

Rear Window Wiper Arm Replacement

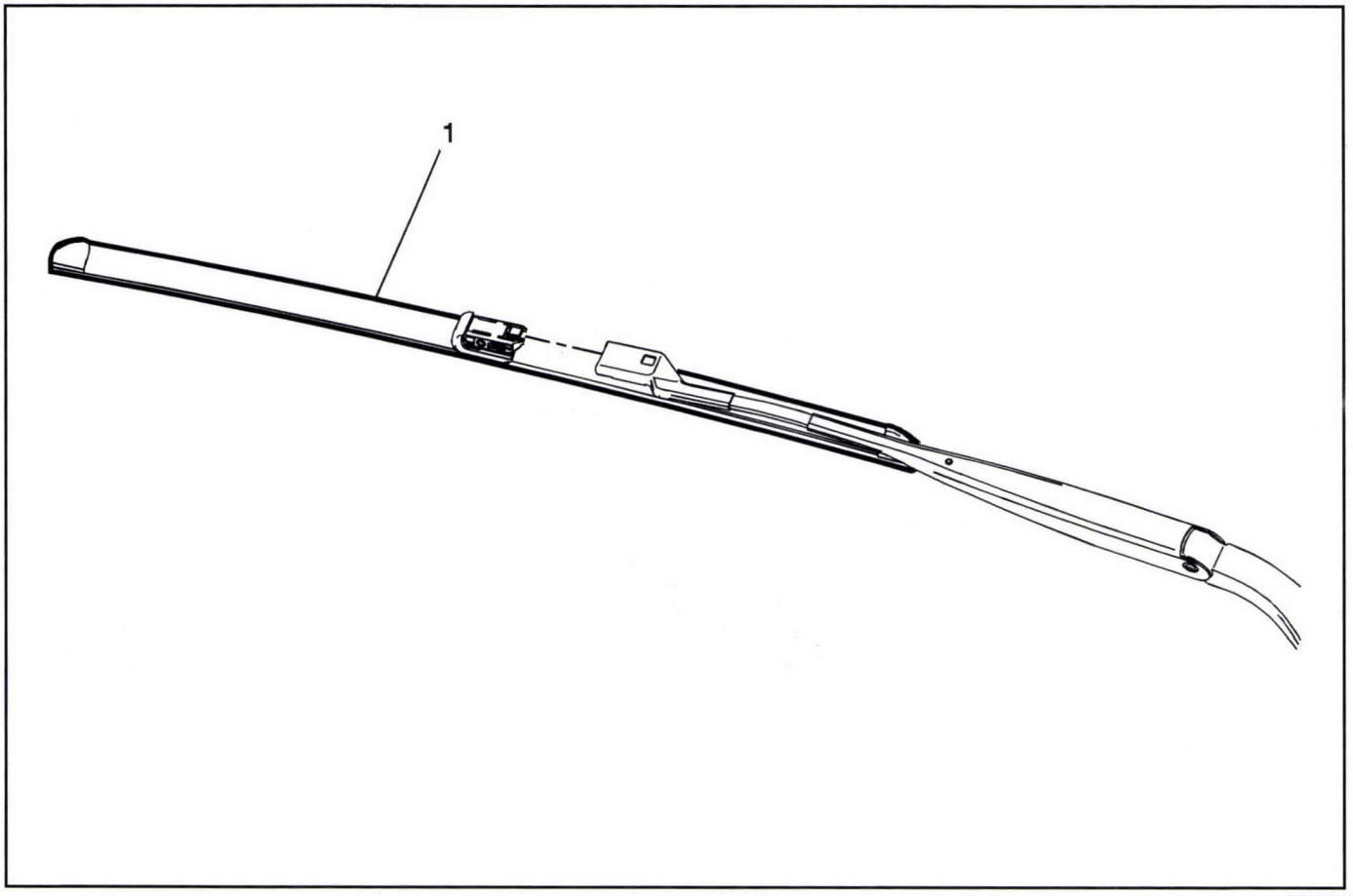


2309174

Rear Window Wiper Arm Replacement

Callout	Component Name
1	Rear Window Wiper Arm Finish Cap **Procedure** Use a small flat-bladed tool to remove.
2	Rear Window Wiper Arm Nut **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 13 N•m (10 lb ft)
3	Rear Window Wiper Arm **Note:** Use the wiper arm puller if the arm fails to release from the wiper motor pivot shaft.

Windshield Wiper Blade Replacement

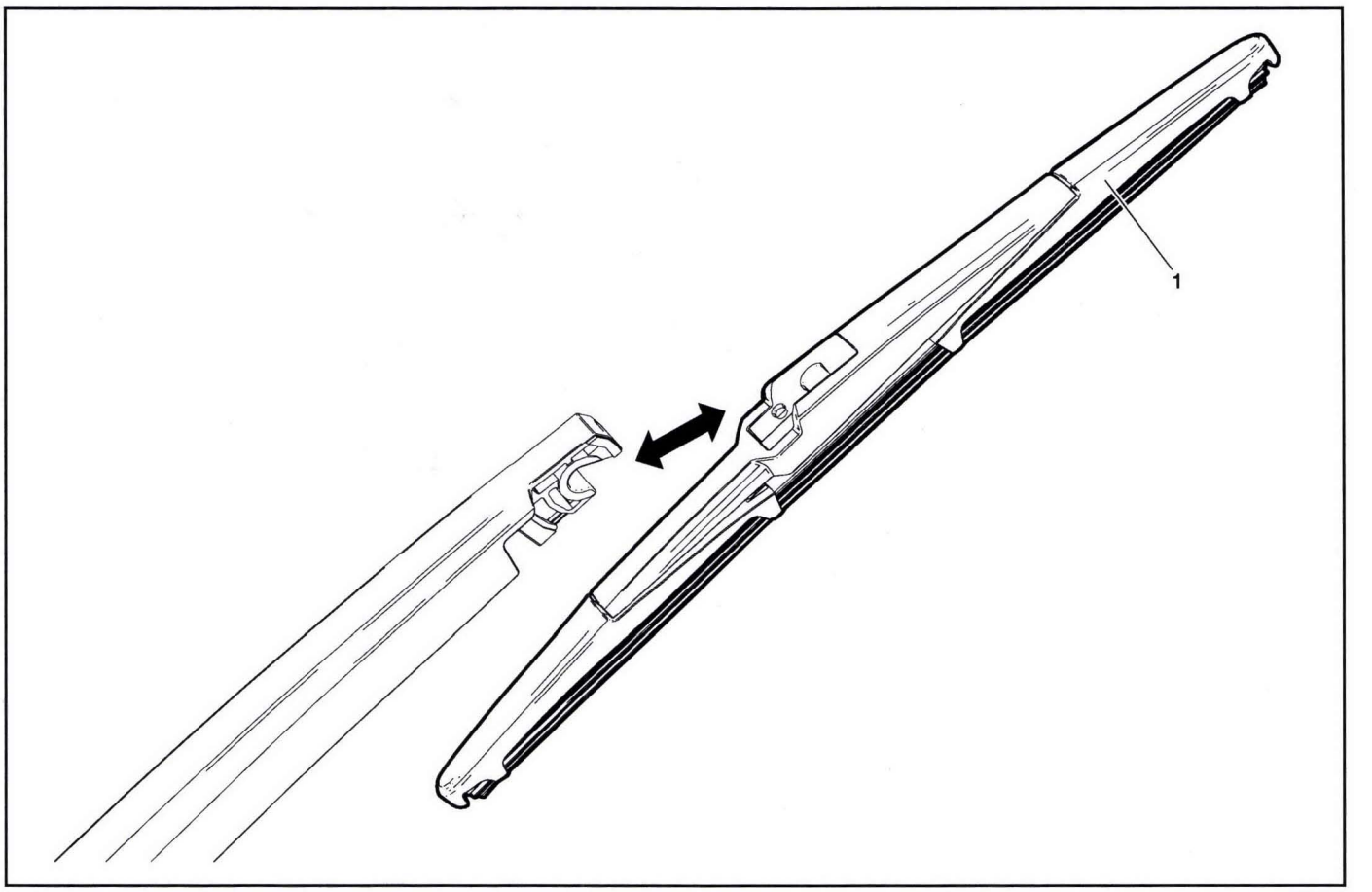


3213139

Windshield Wiper Blade Replacement

Callout	Component Name
1	Windshield Wiper Blade **Procedure** 1. Lift windshield wiper arm off of the windshield. 2. Press the square tab to release the windshield wiper blade and pull straight from the windshield wiper arm.

Rear Window Wiper Blade Replacement

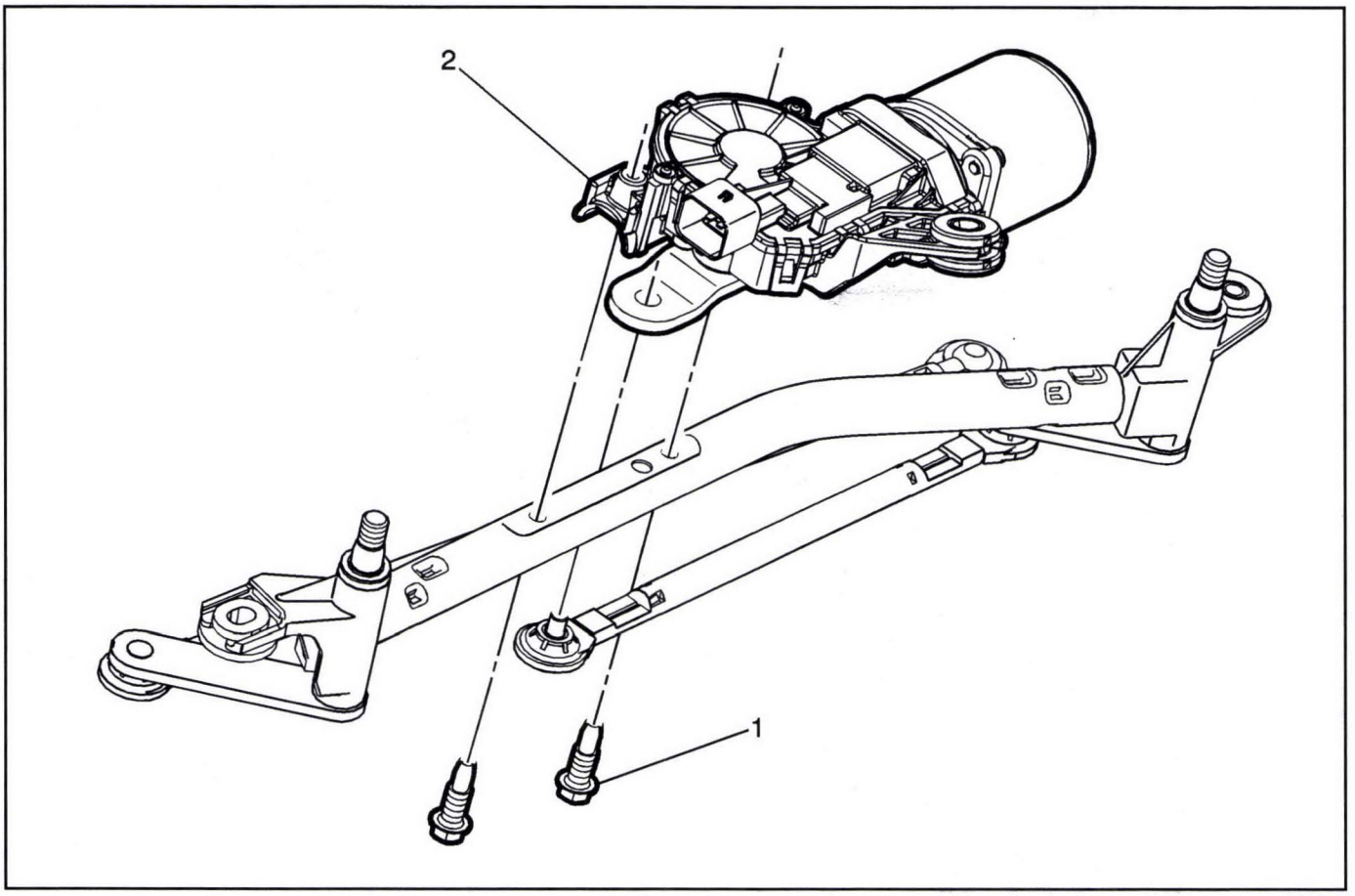


2309178

Rear Window Wiper Blade Replacement

Callout	Component Name
1	Rear Window Wiper Blade **Procedure** 1. Lift rear window wiper arm off of the liftgate window 2. Pull firmly to release the rear window wiper blade from the rear window wiper arm.

Windshield Wiper Motor Replacement

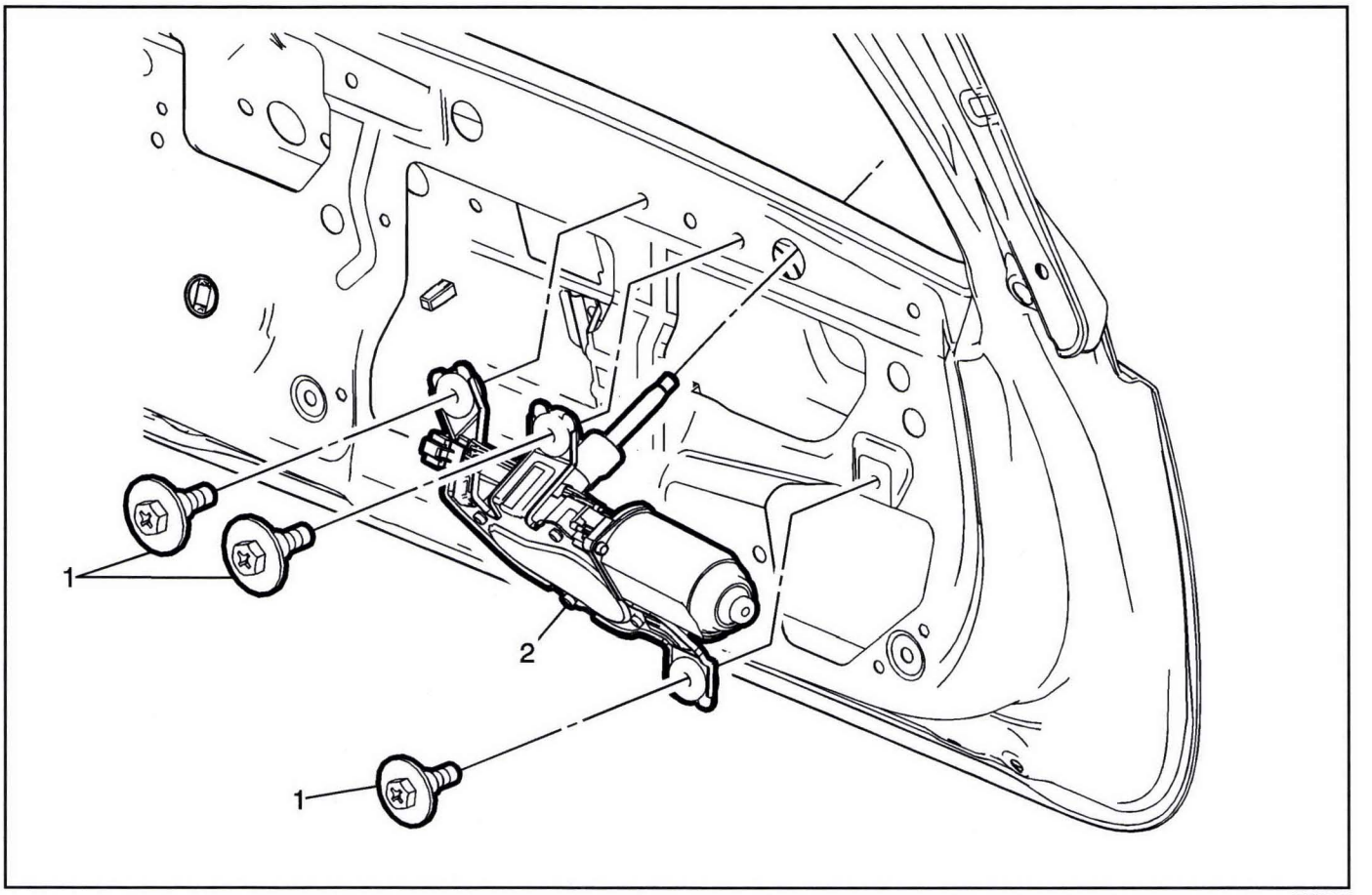


3213145

Windshield Wiper Motor Replacement

Callout	Component Name
Preliminary Procedure Remove the windshield wiper system module. Refer to *Windshield Wiper System Module Replacement on page 4-334*.	
1	Windshield Wiper Motor Bolt (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 13 N•m (10 lb ft)
2	Windshield Wiper Motor **Procedure** Use a separator or similar tool to release the windshield wiper motor crank arm from the windshield wiper system module link.

Rear Window Wiper Motor Replacement

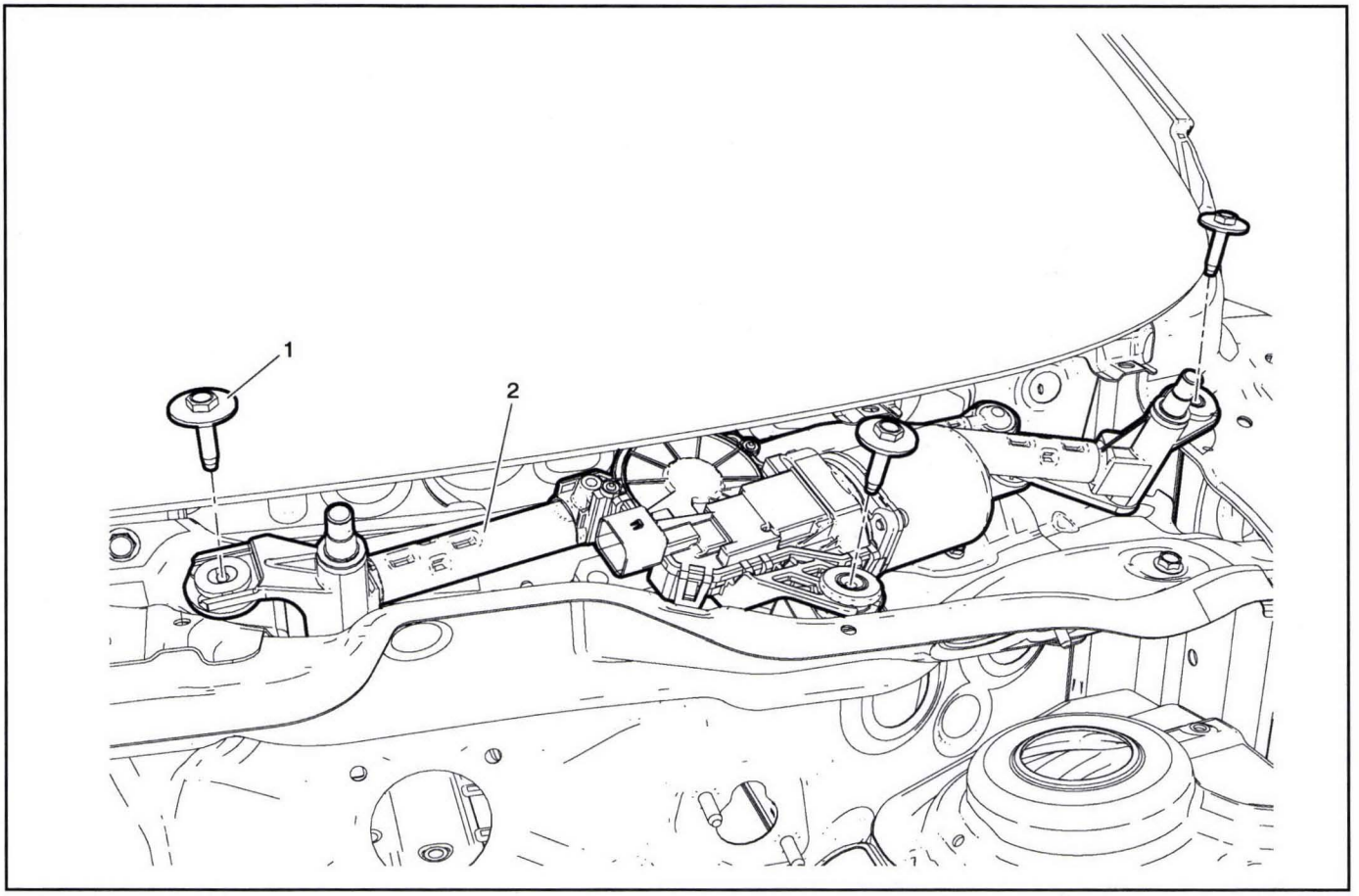


2969579

Rear Window Wiper Motor Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the rear window wiper arm. Refer to *Rear Window Wiper Arm Replacement on page 4-329*. 2. Remove the liftgate trim panel. Refer to *Liftgate Trim Finish Panel Replacement on page 2-70*.	
1	Rear Window Wiper Motor Bolt (Qty: 3) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 8 N•m (71 lb in)
2	Rear Window Wiper Motor **Procedure** Disconnect the electrical connector.

Windshield Wiper System Module Replacement



2309186

Windshield Wiper System Module Replacement

Callout	Component Name
Preliminary Procedure Remove the air inlet grille panel. Refer to *Air Inlet Grille Panel Replacement on page 4-327*.	
1	Windshield Wiper System Module Bolt (Qty: 3) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 10 N•m (89 lb in)
2	Windshield Wiper System Module

Windshield Glass Cleaning

Exterior:

Clean the windshield with windshield cleaner, GM P/N 19287404 (18 oz.) or 19259280 (6 oz.) (Canadian P/N 88865156) or equivalent. The cleaner should not harm the paint finish or scratch the glass. The glass is clean when the water no longer beads, but sheets across the entire glass surface.

Interior:

The interior glass should be cleaned with plain water only applied with a clean terry cloth towel. Water only eliminates any film or haze on the window and helps prevent fogging.

Wiper Blade Element Cleaning

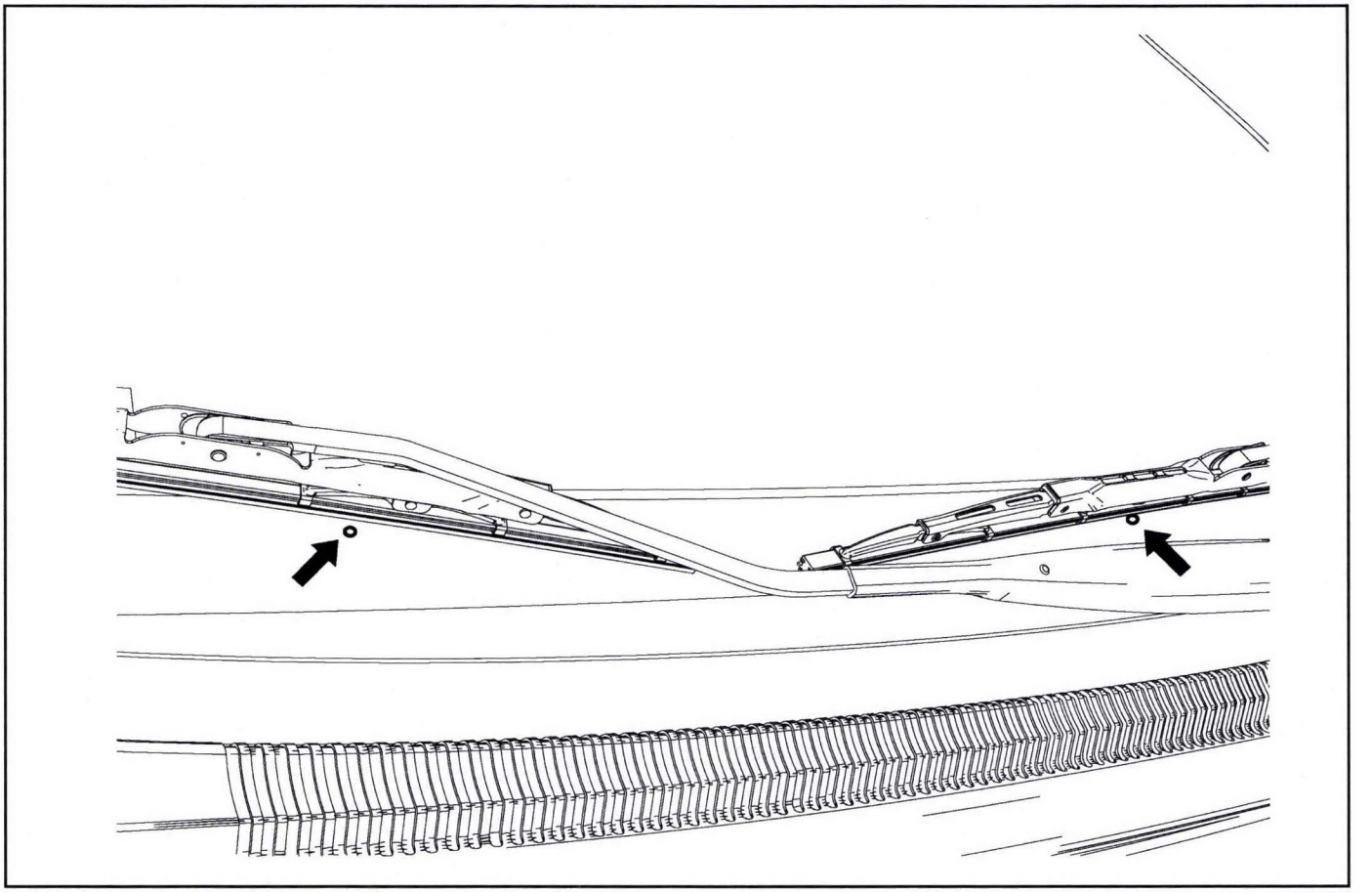
Lift each blade assembly off of the windshield and clean the element with a cloth saturated with full strength washer solvent. Then rinse the blade assemblies with clear water.

Wiper Chatter Repair

Some vehicles may exhibit a condition where the windshield wipers chatter and/or wipe unevenly. Several items may contribute to this condition. To completely repair this condition, ALL of the items listed should be tested and repaired as necessary.

- Clean the windshield glass. Refer to *Windshield Glass Cleaning on page 4-334*.
- Clean the wiper blade elements. Refer to *Wiper Blade Element Cleaning on page 4-334*.
- Inspect the wiper blade element set.

Windshield Wiper Arm Adjustment



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Windshield Wiper Arm Adjustment

Callout	Component Name
Tip: When installing the windshield wiper arm, perform this procedure for wiper arm to be in original position.	
1. Check the mark to install the wiper arm at the lower blackout of the windshield.	
2. Position the wiper arm blade to this mark.	

Description and Operation

Wiper/Washer System Description and Operation

Wiper/Washer System Components

The wiper/washer system consists of the following electrical components:

- Windshield Wiper Relay
- Windshield Wiper Speed Control Relay
- Windshield Washer Pump Relay
- Windshield Washer Pump
- Windshield Wiper Motor
- Windshield Wiper/Washer Switch
- Windshield Wiper Motor Fuse
- Windshield Washer Pump Fuse
- Body Control Module (BCM)
- Rear Wiper Motor
- Rear Wiper Motor Fuse
- Rear Wiper Relay
- Rear Washer Pump Relay
- Rear Washer Pump Fuse

Windshield Wiper System

The body control module (BCM) determines the front wipe/wash system mode of operation by monitoring several signals from the Windshield Wiper/Washer Switch as indicated in the wiper switch.

The Windshield Wiper/Washer Switch receives a reference ground signal from the BCM. Each input of the BCM provides a switched battery pull-up for each front wiper/washer switch output signal it receives. All the BCM inputs are recognized as active when the wiper switch provides a path to the referenced ground signal. The first signal received by the BCM is the result of 6 resistors in the front wiper switch configured as a resistor ladder network. This signal is connected to a BCM analog to digital input. Depending on the function selected (High, Low, Intermittent 1 thru 5, Mist, Off), the Windshield Wiper/Washer Switch connects a different set of resistors into the circuit resulting in different voltages appearing on the BCM A/D input. By monitoring this voltage, the BCM determines how to control the wiper motor On/Off Relay. It should be noted that High, Low, and Mist all have the same value on this signal circuit. The second signal received from the front wiper switch is active only when the front wiper switch is in the high speed wiper position. When the wiper switch is not in the high speed position, the switch is open and the signal circuit is pulled to battery by the BCM. When the wiper switch is in the high speed position, the switch pulls the circuit low. The BCM determines how to control the Wiper high/low speed relay from this input. The third signal received from the front wiper switch is from the momentary windshield wash control switch. When the washer switch is not active the switch is open and the signal circuit is pulled to battery by the BCM. When the washer switch is active, the switch pulls the circuit low. The BCM controls the windshield wash and windshield wash activated wiper operation based on this input.

The BCM controls Windshield Wiper Motor operation through two output signals and the monitoring of one input signal. The two outputs (one high side drive, one low side drive) are used to control two external wiper motor relays: Windshield Wiper Motor on/off relay: which provides the wiper motor with battery power when it is activated by the high side drive signal (switched battery) from the BCM. When left deactivated, the normally closed contacts provide a ground to the wiper motor. Wiper high/low speed relay: when activated by a low side drive signal (ground) from the BCM, it switches the power supplied by the wiper motors on/off relay to the motors high speed input. When left deactivated, the normally closed contacts connect the power supplied by the wiper motors on/off relay to the motors low speed input. The input used by the BCM is from the park switch located in the wiper motor assembly. When the wiper blades are not in the park position, the wiper park switch is open and the circuit is pulled up to battery by the BCM. When the wiper blades are in the park position at the bottom of the glass, the wiper park switch closes to ground pulling the park signal circuit low.

To initiate low speed operation, the BCM only energizes the front Windshield Wiper Motor on/off relay. This allows battery voltage from the wiper fuse to be applied through the switched contacts of the wiper motor on/off relay, through the normally closed contacts of the wiper high/low speed relay, to the low speed control circuit of the windshield wiper motor.

Redundant high speed switch pass through. The BCM provides redundant circuitry which places battery power on its wiper motor on/off relay output with activation of its low assertion high speed wiper switch input. The BCM shall be capable of doing this, even if the module has lost all microprocessor control. This redundant circuit shall supply power while in the RUN and CRANK power modes. however; while in the CRANK power mode, the pass through shall only be active if the BCM is NOT in a computer operating properly state.

To initiate high speed operation, the BCM energizes both the Windshield Wiper Motor on/off relay and the wiper high/low speed relay . This allows battery voltage from the wiper fuse to be applied through the switched contacts of the wiper motor on/off relay, through the switched contacts of the wiper high/low speed relay, to the high speed control circuit of the windshield wiper motor.

Parking the wiper motor. In order to perform an accurate read of the park switch and to ensure the wipers will come to rest while still in the park position, parking of the wipers only occurs while in a low speed wiper mode. This requires that if the wipers are performing a high speed wiper operation at the time they are required to park, the BCM shall transition the Wipers to low speed by deactivating the wiper high/low relay before attempting to park. In order to park the wipers, the BCM monitors the park circuit until the park switch pulls the park circuit to ground. At this time, the BCM will immediately deactivate the wiper motor on/off relay. The relay contacts will switch back to their normally closed position and will apply ground to the

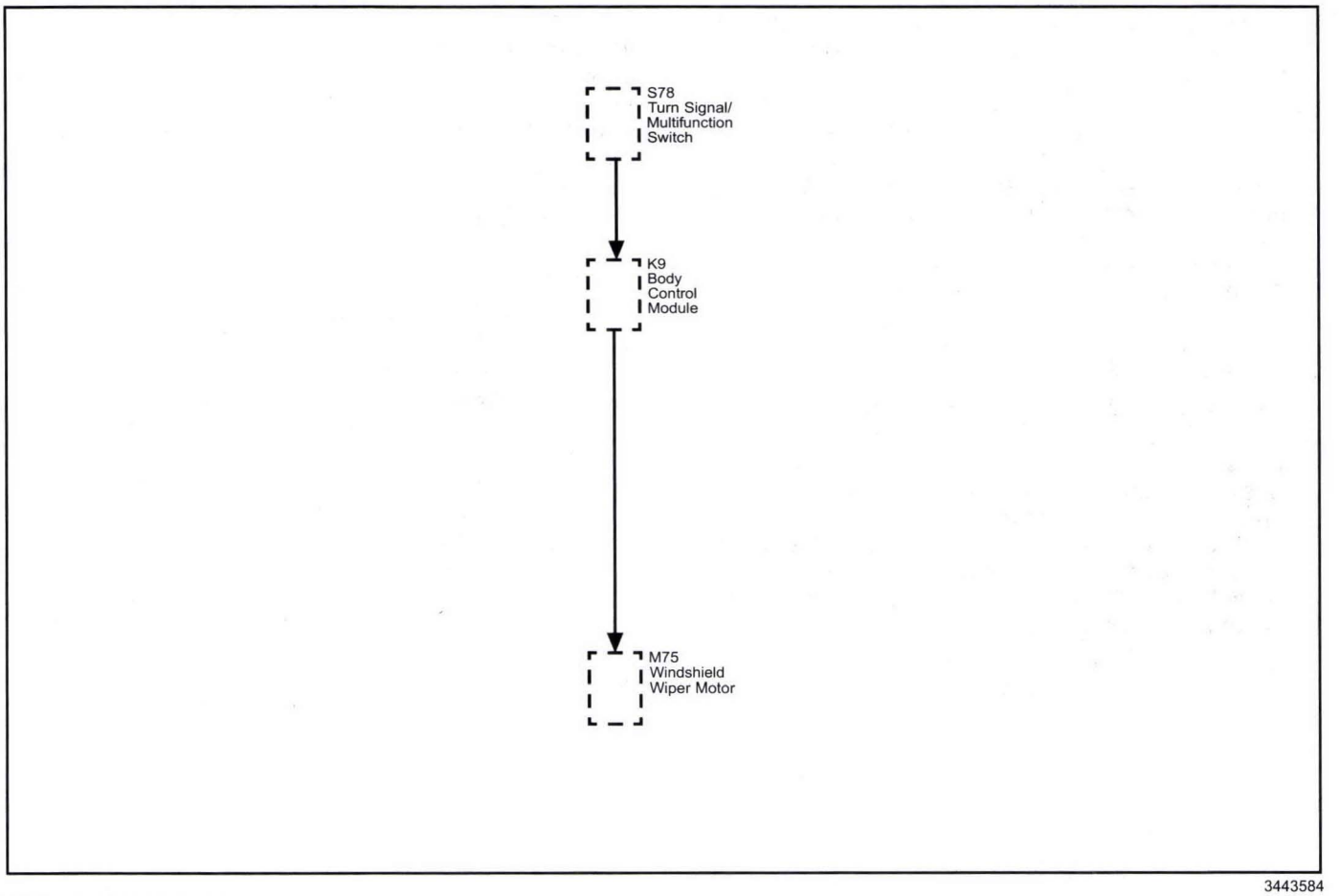
wiper motor power inputs through the normally closed contacts of the wiper high/low relay. This deactivates and dynamically brakes the wiper motor in the park position. When the wiper switch is turned to the OFF position while the wiper motor is somewhere in mid-cycle, the BCM will continue to operate the motor until the wipers reach the park position. If the BCM is running the wiper motor and does not see a state transition of the park switch after 8 s, the wipers will stop immediately when the wiper switch is turned to OFF. If the ignition is turned OFF while the wipers are in mid-cycle, the wipers will stop immediately, regardless of position. The BCM will park the wipers next time the ignition is turned ON.

The windshield wiper system MIST operation is identical to LOW speed operation, except that the MIST switch is a press and release type switch. When the wiper switch is moved to the MIST position and released, low speed wiper motor operation is started and will continue until 1 cycle is complete. If the wiper switch is moved to the MIST position and held, the wiper motor will operate in the LOW speed mode until the switch is released.

Windshield wiper intermittent operation is a low speed wiper motor function with a variable delay interval between the wiper motor cycles. The duration of the delay is controlled by the front wiper control switches intermittent 1 through intermittent 5 settings. The wiper operation is as follows

1. The BCM will initiate a single wipe by activating its windshield wiper ON/OFF relay output.
2. At the completion of a single wipe, the BCM will park the wipers as described above.
3. The BCM will then pause the wipers in their park position for the time duration associated with intermittent delay switch setting.
4. When the delay time expires repeat Steps 1 and 3 until the system is turned off or taken out of intermittent mode. If the wiper switch is moved from a longer delay interval to a shorter delay interval, the BCM will command an immediate wipe cycle and reset the delay timer to the shorter delay interval.

Intermittent wiper operation may be vehicle speed sensitive. When enabled, the speed compensated intermittent feature causes the intermittent wiper delay intervals to become shorter as a function of increased speed. As vehicle speed is reduced the intervals will become closer to the predetermined



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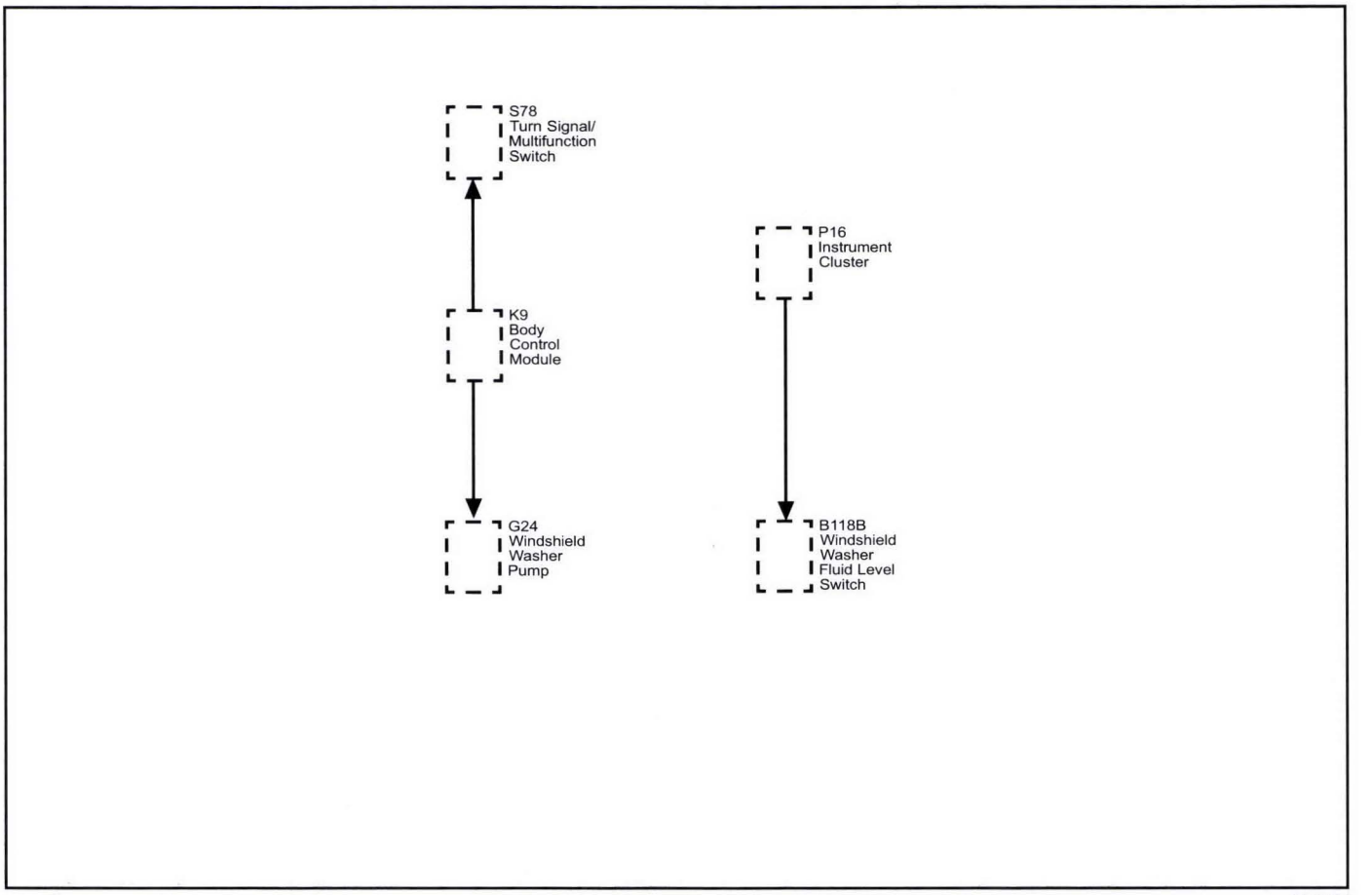
Windshield Washer System

The BCM controls the windshield wash operation and windshield wash activated wiper operation. When the BCM detects the activation of the momentary windshield wash control switch, it activates its washer pump relay drive output which supplies battery power to the coil of the washer pump relay. This energizes the relay, which switches battery power to the pump motor. The BCM will also activate continuous low speed windshield wipes as described above. Upon deactivation of the windshield wash control switch, the body control module (BCM) shall deactivate the wash motor and will also park the wiper motor as described above unless the drip wipe feature is enabled. On some vehicles the drip wipe feature will be enabled and cause the system to provide additional wiping of the windshield after the switch has been released and fluid is no longer being applied. The windshield washer switch feature may attempt to detect a stuck switch. When enabled, activation of the wash feature shall be limited to 10 seconds.

On vehicles with the Rear Wash feature a single reversing wash motor may be utilized for both the front and rear wash operation. In this system the wash motor is operated in one direction to spray fluid on the front windshield and then operated in the reverse direction to spray fluid on the rear window. The BCM Controls the reversing wash motor through two High Side Drive outputs. One controls the Windshield Wiper Motor Relay and one controls the Rear Wiper Relay.



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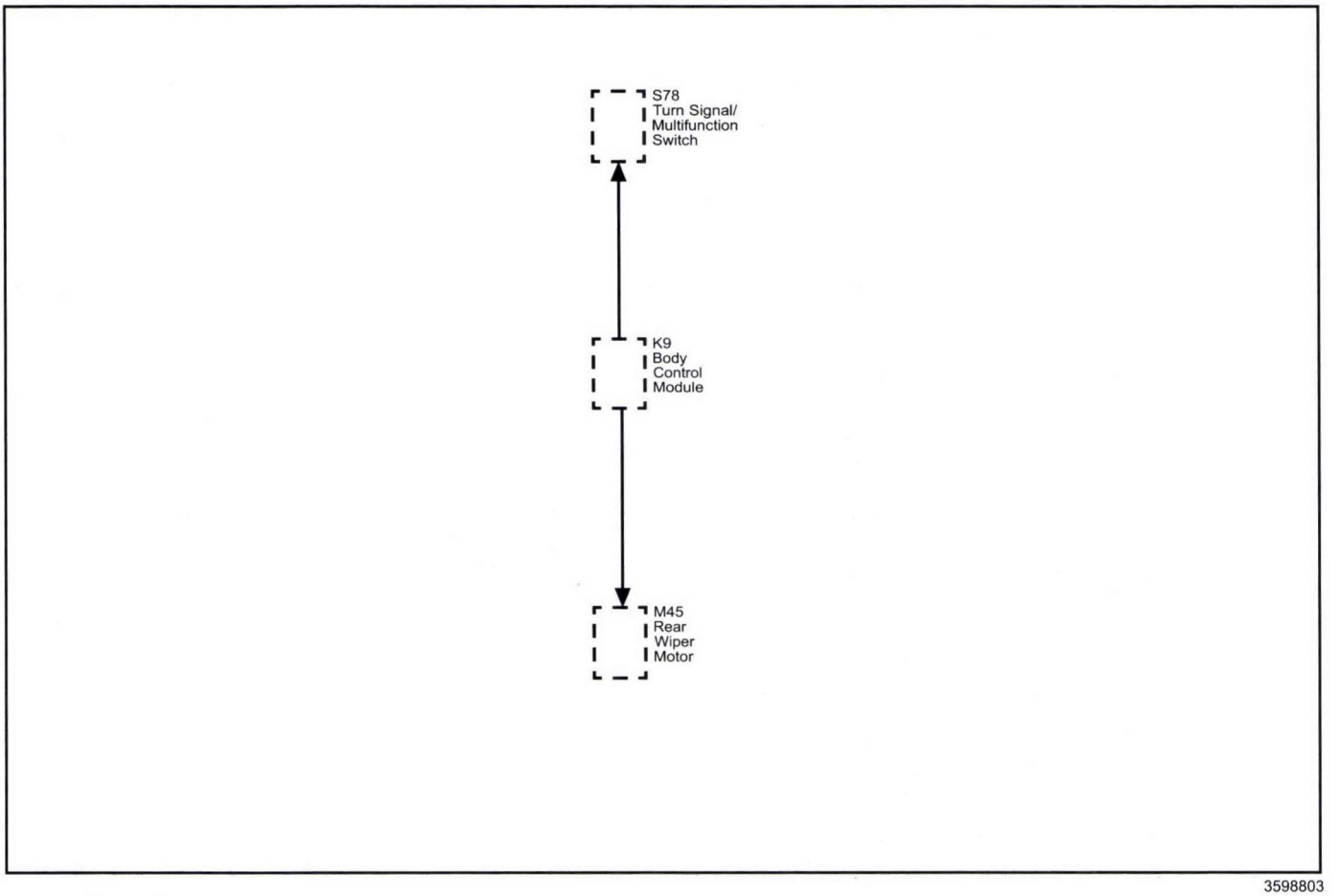
Rear Wiper System

On vehicles equipped with a Rear Wiper, the BCM determines of the Rear Wipe/Wash System Mode of Operation by monitoring the multiplexed output of the Windshield Wiper/Washer Switch. The Rear Wiper Relay uses a reference ground signal from the BCM. The BCM provides a switched Battery pull-up for the Rear Wiper Relay switch output signal it receives. All the BCM inputs are recognized as active when the Rear Wiper Relay switch provides a path to the referenced ground signal. The Rear Wiper/Washer signal received by the BCM is the result of 3 resistors in the Windshield Wiper/Washer Switch configured as a resistor ladder network. This signal is connected to a BCM Analog to Digital Input which also provides a switched Battery pull-up for the circuit. Depending on the function selected (Low, Intermittent, Off, Wash), the Rear Wiper Control Switch connects a different set of resistors into the circuit resulting in different voltages appearing on the BCM A/D input. By monitoring this voltage, the BCM determines how to control the Rear Wiper Relay and the Rear Washer Relay.

The BCM Controls the single speed Rear Wiper Motor by its Active High output to the external Rear Wiper Relay. When the BCM activates its output and applies Battery to the coil of the relay, the relay energizes, allowing Battery voltage from the fuse to be applied through the switched contacts of the Rear Wiper Relay to the Rear Wiper Motors control input. The motor then operates continuously at low speed. The BCM does not control the parking of the Rear Wiper Motor, it is self parking. When the BCM deactivates its output, the contacts of the Rear Wiper Relay switch back to ground which will be used by the wiper for Dynamic Braking. The Rear Wipers internal park switch and circuitry will sustain motor operation until the wiper arm has returned to its Park position.



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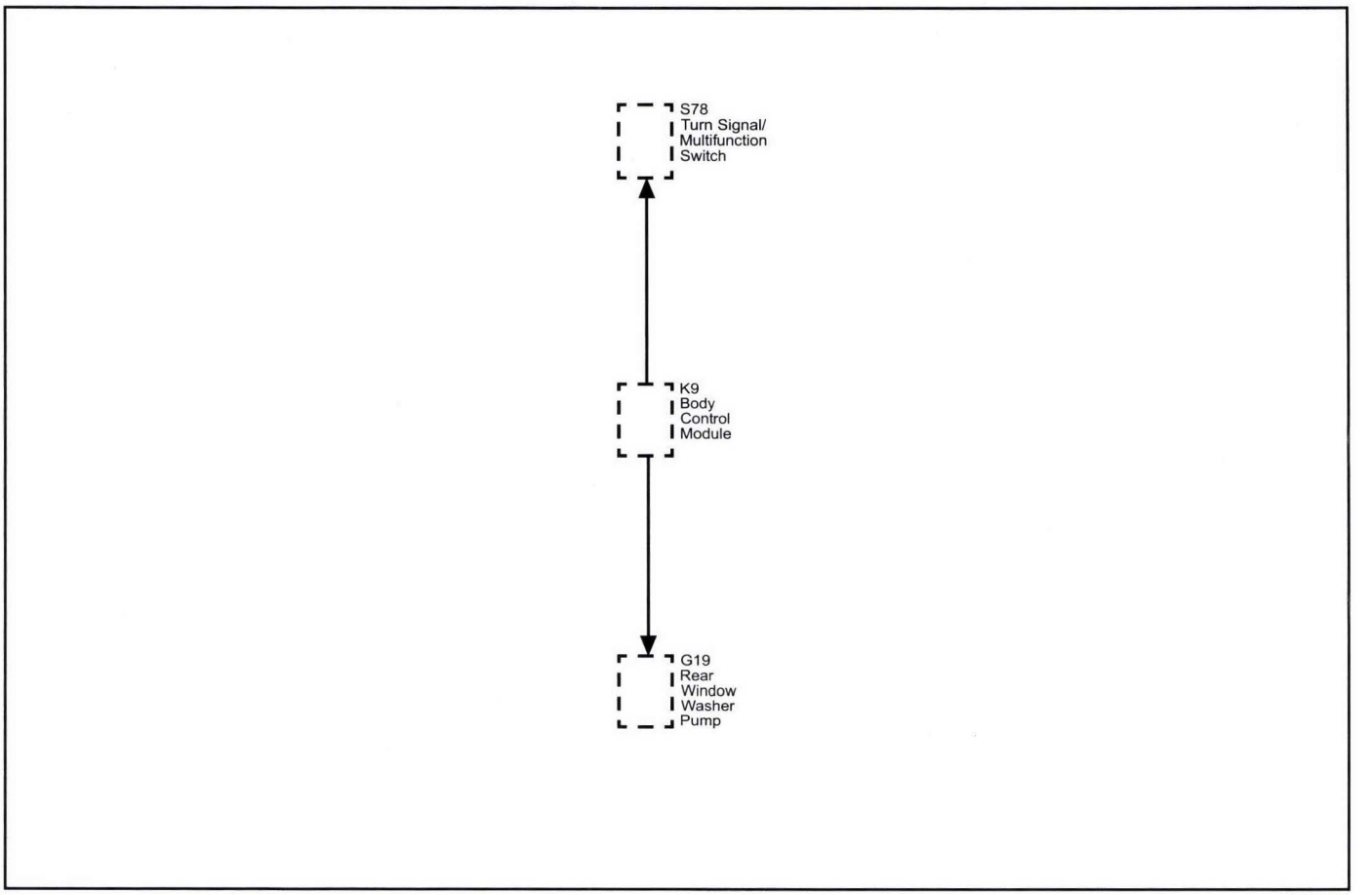
Rear Wash

When the Body Control Module detects that the Rear wiper/washer switch has activated the momentary Wash switch, it activates a High Side Drive output which supplies Battery to the coil of the Rear Washer Pump Relay. This energizes the Relay, which switches Battery Power to the Washer Pump Motor. The BCM will also activate continuous Low Speed Windshield Wipers as described above. The BCM software will attempt to detect a stuck Rear Wash Switch. A stuck Rear Wash Switch condition is detected if the Rear Wash Motor Relay Output has been continuously active for 10 seconds or more. Upon detecting this the BCM will fail soft the state of the Rear Wash Control to Inactive. This shall cause the System to perform as if the momentary Wash control had been released.


S78
Turn Signal/
Multifunction
Switch
K9
Body
Control
Module
G19
Rear
Window
Washer
Pump

3598804

BLANK

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BLANK

Antilock Brake System

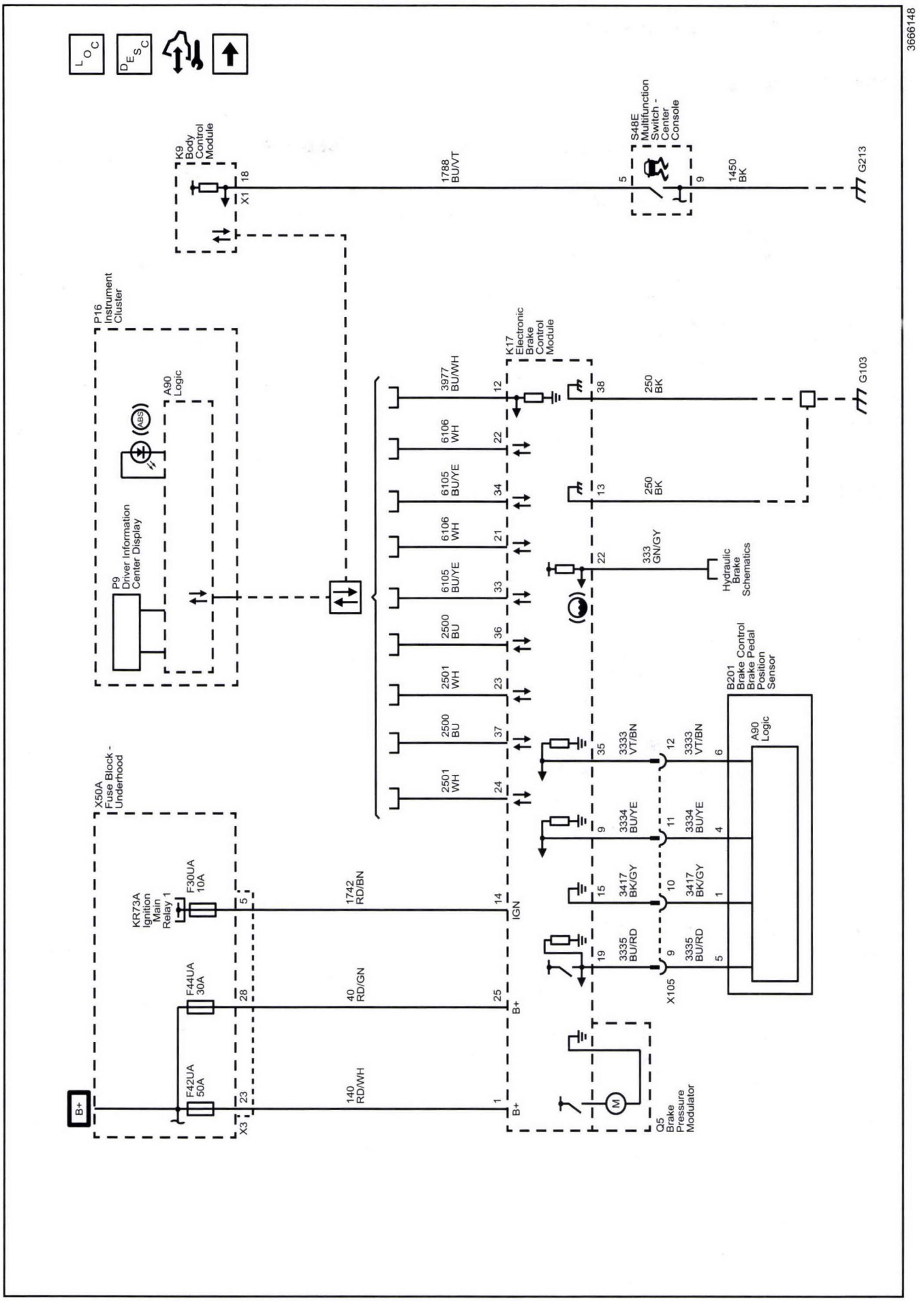
Specifications

Fastener Tightening Specifications

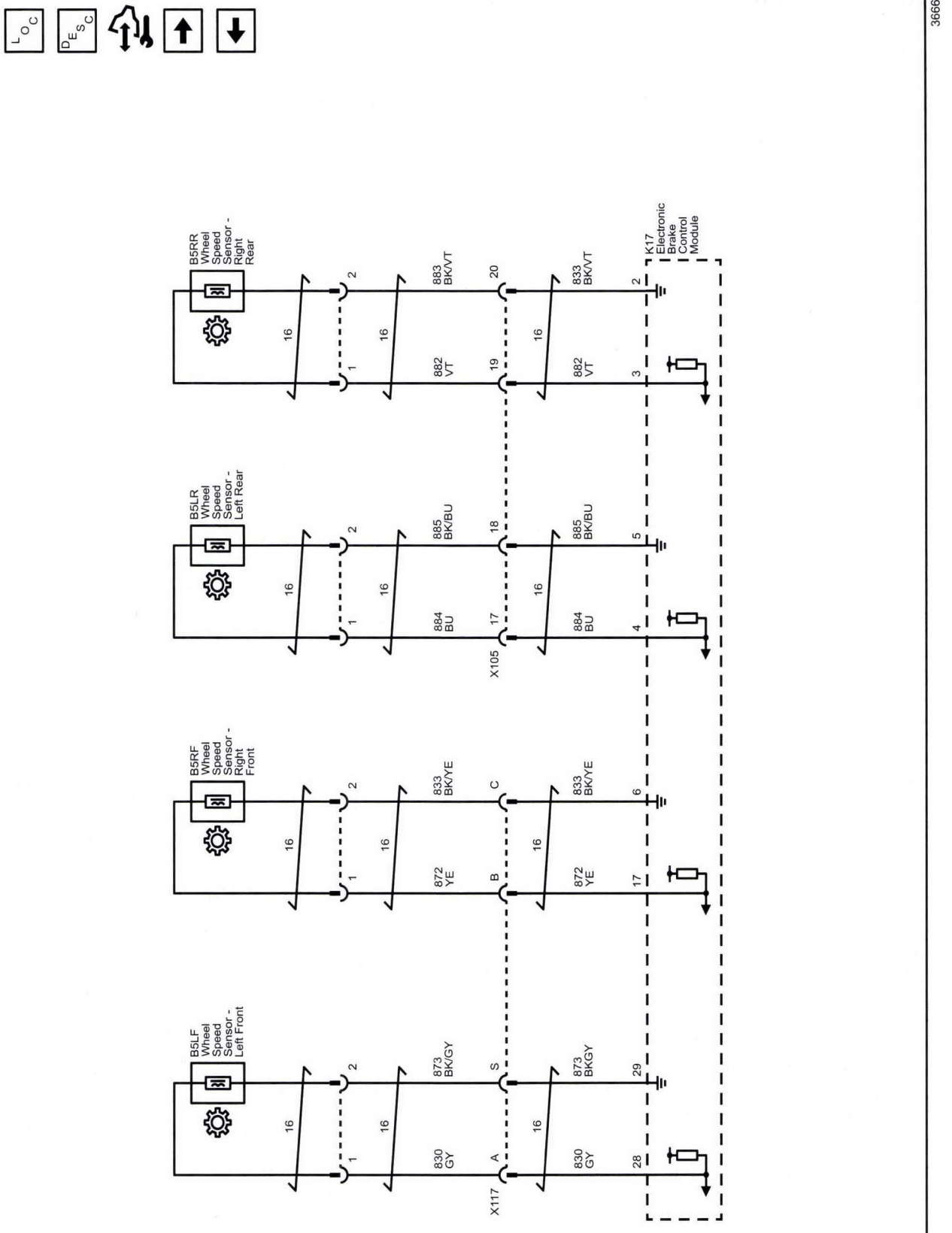
Application	Specification	
	Metric	English
Brake Pipe Fitting	18 N•m	13 lb ft
Brake Pressure Modulator Valve Assembly Bolt	22 N•m	16 lb ft
Brake Pressure Modulator Valve Assembly Nut	22 N•m	16 lb ft
Brake Pressure Modulator Valve Bolt	8 N•m	71 lb in
Brake Pressure Modulator Valve Bracket Bolt	3 N•m	27 lb in
Drive Motor Power Inverter Module Cable Fastener	9 N•m	80 lb in
Electronic Brake Control Module Bolt	3 N•m	27 lb in
Wheel Speed Sensor Bolt	8 N•m	71 lb in

Schematic and Routing Diagrams

Antilock Brake System Schematics (Module Power, Ground, and Subsystem References)



Antilock Brake System Schematics (Wheel Speed Sensors)



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Diagnostic Information and Procedures

DTC B2745

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC B2745 02: Traction Control Switch Circuit Short to Ground

DTC B2745 71: Traction Control Switch Circuit Invalid Data

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B2745 02	1	1	B2745 71
Ground	—	1	—	—
1. Traction control switch inoperative				

Circuit/System Description

The body control module monitors the signal circuit from the traction control switch. When the traction control switch is pressed once, the body control module will request the electronic brake control module via serial data to disable the traction control. The electronic brake control module will request the instrument cluster via serial data to turn the digital traction control Off indicator ON to notify the driver of the deactivation.

When the traction control switch is pressed and held for five seconds, the body control module will request the electronic brake control module to disable the electronic stability control. The electronic brake control module will request the instrument cluster via serial data to turn the digital traction control Off and the stability control Off indicators ON to notify the driver of the deactivation.

Conditions for Running the DTC

- Vehicle On or Vehicle in Service Mode.
- Ignition voltage is greater than 8 V.

Conditions for Setting the DTC

B2745 02

The body control module detects a short to ground on the signal circuit.

B2745 71

The body control module detects an erratic signal or invalid serial data from the traction control switch.

Action Taken When the DTC Sets

- The body control module stores the DTC.
- The electronic brake control module disables the traction and the electronic stability control for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The conditions for setting the DTC are no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Body Control Module Traction Control Switch parameter changes between Active and Inactive while pressing and releasing the traction control switch.

⇒ **If the parameter does not change**

Refer to Circuit/System Testing.

⇓ **If the parameter changes**

3. All OK.

Circuit/System Testing

1. Vehicle OFF, scan tool disconnected, and all vehicle systems OFF, disconnect the harness connector at the S48E Multifunction Switch-Center Console. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 9 and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Body Control Module Traction Control Switch parameter is Inactive.

⇒ **If not Inactive**

4.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit terminal 14 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 5 and the ground circuit terminal 9.
6. Verify the scan tool Traction Control Switch parameter is Active.

⇒ **If not Active**

6.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in service mode.

6.2. Test for less than 1 V between the signal circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Vehicle OFF.

6.4. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

7. Test or replace the S48E Multifunction Switch-Center Console.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the S48E Multifunction Switch-Center Console.
2. Test for infinite resistance between the signal terminal 5 and the ground terminal 9 with the switch in the open position.

⇒ **If less than infinite resistance**

Replace the S48E Multifunction Switch-Center Console.

⇓ **If infinite resistance**

3. Test for less than 2 Ω between the signal terminal 5 and the ground terminal 9 with the switch in the closed position.

⇒ **If 2 Ω or greater**

Replace the S48E Multifunction Switch-Center Console.

⇓ **If less than 2 Ω**

4. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Vehicle Stability Control System Switch Replacement on page 5-90*
- *Control Module References on page 6-3* for body control module replacement, programming and setup

DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C0035 04: Left Front Wheel Speed Sensor Circuit Open
DTC C1232 00: Left Front Wheel Speed Sensor Circuit Low Input
DTC C0035 26: Left Front Wheel Speed Sensor Circuit Low Frequency
DTC C1221 00: Left Front Wheel Speed Sensor Circuit Malfunction
DTC C0035 27: Left Front Wheel Speed Sensor Circuit High Frequency
DTC C1225 00: Left Front Wheel Speed Sensor Circuit Performance
DTC C0035 0E: Left Front Wheel Speed Sensor Circuit Low Resistance
DTC C1207 00: Left Front Wheel Speed Sensor Circuit High Input
DTC C0035 1F: Left Front Wheel Speed Sensor Circuit Erratic
DTC C1221 00: Left Front Wheel Speed Sensor Circuit Malfunction
DTC C0040 04: Right Front Wheel Speed Sensor Circuit Open
DTC C1233 00: Right Front Wheel Speed Sensor Circuit Low Input
DTC C0040 0E: Right Front Wheel Speed Sensor Circuit Low Resistance
DTC C1208 00: Right Front Wheel Speed Sensor Circuit High Input
DTC C0040 1F: Right Front Wheel Speed Sensor Circuit Erratic
DTC C1222 00: Right Front Wheel Speed Sensor Circuit Malfunction
DTC C0040 26: Right Front Wheel Speed Sensor Circuit Low Frequency
DTC C1222 00: Right Front Wheel Speed Sensor Circuit Malfunction
DTC C0040 27: Right Front Wheel Speed Sensor Circuit High Frequency
DTC C1226 00: Right Front Wheel Speed Sensor Circuit Performance
DTC C0045 04: Left Rear Wheel Speed Sensor Circuit Open
DTC C1234 00: Left Rear Wheel Speed Sensor Circuit Low Input
DTC C0045 0E: Left Rear Wheel Speed Sensor Circuit Low Resistance
DTC C1209 00: Left Rear Wheel Speed Sensor Circuit High Input
DTC C0045 1F: Left Rear Wheel Speed Sensor Circuit Erratic
DTC C1223 00: Left Rear Wheel Speed Sensor Circuit Malfunction
DTC C0045 26: Left Rear Wheel Speed Sensor Circuit Low Frequency
DTC C1223 00: Left Rear Wheel Speed Sensor Circuit Malfunction
DTC C0045 27: Left Rear Wheel Speed Sensor Circuit High Frequency
DTC C1227 00: Left Rear Wheel Speed Sensor Circuit Performance
DTC C0050 04: Right Rear Wheel Speed Sensor Circuit Open
DTC C1235 00: Right Rear Wheel Speed Sensor Circuit Low Input
DTC C0050 0E: Right Rear Wheel Speed Sensor Circuit Low Resistance
DTC C1210 00: Right Rear Wheel Speed Sensor Circuit High Input
DTC C0050 1F: Right Rear Wheel Speed Sensor Circuit Erratic
DTC C1224 00: Right Rear Wheel Speed Sensor Circuit Malfunction
DTC C0050 26: Right Rear Wheel Speed Sensor Circuit Low Frequency
DTC C1224 00: Right Rear Wheel Speed Sensor Circuit Malfunction
DTC C0050 27: Right Rear Wheel Speed Sensor Circuit High Frequency
DTC C1228 00: Right Rear Wheel Speed Sensor Circuit Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Front Wheel Speed Sensor Ignition	C0035 0E, C1207 00, C1221 00	C0035 04, C1221 00, C1232 00	—	C0035 1F C1221 00, C0035 26 C1221 00, C0035 27 C1225 00
Left Front Wheel Speed Sensor Signal	C0035 04, C1221 00, C1232 00	C0035 04, C1221 00, C1232 00	C0035 0E, C1207 00, C1221 00	C0035 1F C1221 00, C0035 26 C1221 00, C0035 27 C1225 00
Right Front Wheel Speed Sensor Ignition	C0040 0E, C1208 00, C1222 00	C0040 04, C1222 00, C1233 00	—	C0040 1F C1222 00, C0040 26 C1222 00, C0040 27 C1226 00
Right Front Wheel Speed Sensor Signal	C0040 04, C1222 00, C1233 00	C0040 04, C1222 00, C1233 00	C0040 0E, C1208 00, C1222 00	C0040 1F C1222 00, C0040 26 C1222 00, C0040 27 C1226 00
Left Rear Wheel Speed Sensor Ignition	C0045 0E, C1209 00, C1223 00	C0045 04, C1223 00, C1234 00	—	C0045 1F C1223 00, C0045 26 C1223 00, C0045 27 C1227 00
Left Rear Wheel Speed Sensor Signal	C0045 04, C1223 00, C1234 00	C0045 04, C1223 00, C1234 00	C0045 0E, C1209 00, C1223 00	C0045 1F C1223 00, C0045 26 C1223 00, C0045 27 C1227 00
Right Rear Wheel Speed Sensor Ignition	C0050 0E, C1210 00, C1224 00	C0050 04, C1224 00, C1235 00	—	C0050 1F C1224 00, C0050 26 C1224 00, C0050 27 C1228 00
Right Rear Wheel Speed Sensor Signal	C0050 04, C1224 00, C1235 00	C0050 04, C1224 00, C1235 00	C0050 0E, C1210 00, C1224 00	C0050 1F C1224 00, C0050 26 C1224 00, C0050 27 C1228 00

Component	Condition	DTC Symptom Bytes
Wheel Speed Sensor	• Physical damage • Debris on the wheel speed sensor or the encoder ring • Loose or worn wheel bearing • Loose or improperly mounted sensor • Air gap between the wheel speed sensor and the encoder ring too large • Water intrusion in the wiring harness	26, 27 or 1F

Circuit/System Description

The wheel speeds are detected by active wheel speed sensors and encoder rings. The encoder rings consist of permanent magnets located in the hub. As the wheel spins the magnetic encoder ring rotates and passes by the wheel speed sensor head; which generates a sign wave in the wheel speed sensor. Each wheel speed sensor receives ignition voltage from the electronic brake control module and provides an alternating current square wave signal to the electronic brake control module. The electronic brake control module uses the frequency of the signals to calculate the wheel speeds.

Conditions for Running the DTC

- Vehicle On or Vehicle in Service Mode
- Ignition voltage is greater than 10 V.

Conditions for Setting the DTC

C0035 04 – C0050 04 or C1232 00 – C1235 00

- An open or a high resistance is detected on a wheel speed sensor ignition circuit.
- A short to ground or an open/high resistance is detected on a wheel speed sensor signal circuit.

C0035 0E – C0050 0E or C1207 00 – C1210 00

- A short to ground is detected on a wheel speed sensor ignition circuit.
- A short to voltage is detected on a wheel speed sensor signal circuit.

C0035 26 – C0050 26, C0035 27 – C0050 27, C0035 1F – C0050 1F, C1221 00 – C1224 00, or C1225 00 – C1228 00

- The tone ring may be demagnetized
- Water intrusion in the wiring harness
- Incorrectly mounted wheel speed sensor
- Debris on the wheel speed sensor or the tone ring
- Missing tooth or teeth on the wheel speed sensor tone ring
- Air gap between the wheel speed sensor and the tone ring too large
- Electrical magnetic interference with the wheel speed sensor harness

Actions Taken when the DTC Sets

- The ABS indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Diagnostic Aids

- Do not use a magnet to clean the wheel speed sensor magnetic encoder ring.
- Inspect the wheel speed sensor magnetic encoder ring for debris or corrosion.
- If two or more wheel speed sensors are inoperative, diagnose each wheel speed sensor individually.
- If any of the symptom codes 26, 27, or 1F are set, refer to the Diagnostic Fault Information table for possible mechanical faults or conditions.
- If the customer comments that the ABS indicator is ON only during moist environmental conditions (rain, snow, vehicle wash, etc.), inspect the wheel speed sensor wiring for signs of water intrusion.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Test drive the vehicle in a straight line at a speed greater than 20 km/h (13 MPH).
2. Verify all scan tool Wheel Speed Sensor parameters are within 1.6 km/h (1 MPH) of each other.

⇒ **If any parameter is not within 1.6 km/h (1 MPH) of each other**

Refer to Circuit/System Testing.

⇓ **If each parameter is within 1.6 km/h (1 MPH) of each other**

3. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connectors at the appropriate B5 Wheel Speed Sensor and the harness connector at the K17 Electronic Brake Control Module, vehicle in service mode.
2. Test for less than 1 V between the appropriate K17 Electronic Brake Control Module harness connector terminals listed below and ground:
   - B5LF Wheel Speed Sensor – Left Front — terminal 28 and terminal 29
   - B5LR Wheel Speed Sensor – Left Rear — terminal 4 and terminal 5
   - B5RF Wheel Speed Sensor – Right Front — terminal 6 and terminal 17
   - B5RR Wheel Speed Sensor – Right Rear — terminal 2 and terminal 3

⇒ **If 1 V or greater**

Repair the short to voltage on the circuit.

⇓ **If less than 1 V**

3. Vehicle OFF.
4. Test for infinite resistance between the K17 Electronic Brake Control Module harness connector terminals listed below and ground:
   - B5LF Wheel Speed Sensor – Left Front — terminal 28 and terminal 29
   - B5LR Wheel Speed Sensor – Left Rear — terminal 4 and terminal 5

- B5RF Wheel Speed Sensor – Right Front — terminal 6 and terminal 17
- B5RR Wheel Speed Sensor – Right Rear — terminal 2 and terminal 3

⇒ **If less than infinite resistance**

Repair the short to ground on the circuit.

⇓ **If infinite resistance**

5. Test for less than 2 Ω between the B5 Wheel Speed Sensor harness connector terminal 1 and the K17 Electronic Brake Control Module harness connector terminal listed below:
   - B5LF Wheel Speed Sensor – Left Front — terminal 28
   - B5LR Wheel Speed Sensor – Left Rear — terminal 4
   - B5RF Wheel Speed Sensor – Right Front — terminal 17
   - B5RR Wheel Speed Sensor – Right Rear — terminal 3

⇒ **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

⇓ **If less than 2 Ω**

6. Test for less than 2 Ω between the B5 Wheel Speed Sensor harness connector terminal 2 and the K17 Electronic Brake Control Module harness connector terminal listed below:
   - B5LF Wheel Speed Sensor – Left Front — terminal 29
   - B5LR Wheel Speed Sensor – Left Rear — terminal 5
   - B5RF Wheel Speed Sensor – Right Front — terminal 6
   - B5RR Wheel Speed Sensor – Right Rear — terminal 2

⇒ **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

⇓ **If less than 2 Ω**

7. Replace the B5 Wheel Speed Sensor.
8. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

⇒ **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

⇓ **If the DTC does not set**

9. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Front Wheel Speed Sensor Replacement on page 5-84*
- *Rear Wheel Speed Sensor Replacement on page 5-86*
- *Control Module References on page 6-3* for electronic brake control module replacement, programming and setup

DTC C005A

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptor

DTC C005A 00: Simultaneous Malfunction of Both Wheel Speed Sensors on One Axle Malfunction

Circuit/System Description

The wheel speeds are detected by active wheel speed sensors and encoder rings. The encoder ring consists of permanent magnets. Each wheel speed sensor receives ignition voltage from the electronic brake control module and provides an alternating current square wave signal to the electronic brake control module. As the wheel spins, the module uses the frequency of the square wave signal to calculate the wheel speed.

Conditions for Running the DTC

- Vehicle in Service Mode or Vehicle ON
- Ignition voltage is greater than 10 V.
- Two wheel speeds are greater than 5 km/h (3 MPH).

Conditions for Setting the DTC

Simultaneous dropout of both wheel speed sensors on the same axle.

Actions Taken when the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction control/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information center.
- The electronic brake control module disables the antilock brake system, the dynamic rear proportioning, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC C005A is not set.

⇒ **If the DTC is set**

Refer to *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*.

⇓ **If the DTC is not set**

3. All OK.

DTC C0110, C12E0, C12E8, or C12E9

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C0110 00: Pump Motor Circuit Malfunction
DTC C0110 59: Pump Motor Circuit Protection Time-Out
DTC C0110 61: Pump Motor Stuck
DTC C12E0 00: ABS Pump Motor Performance
DTC C12E8 00: ABS Pump Motor Locked
DTC C12E9 00: ABS Pump Motor Stuck On

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	C0110 00, C0256 04, C12E6 00	C0110 00, C0256 04, C12E6 00	—	C0110 00
Ground	—	C0110 00, C056D 00, C12DA 00, C12D7 00	—	—

Component	Condition	DTCs
Pump Motor	• Wear • Damage • Lock	C0110 59, C0110 61, C12E8 00, C12E9 00

Circuit/System Description

The pump motor is a bi-directional motor and is an internal part of the brake pressure modulator. There are three solid state relays in the electronic brake control module that operate the pump. The pump motor runs every few brake stops in order to fill the high pressure accumulator with brake fluid.

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.
- Ignition voltage is greater than 10 V.
- The system enable relay is ON.
- The pump motor has been commanded ON, OFF and ON again.

Conditions for Setting the DTC

- Brake system hydraulic leak
- Excessive brake pedal applies
- Improper hydraulic brake system bleed
- The brake pressure accumulator is not charging.
- The electronic brake control module detects the pump motor runs continuously.
- The electronic brake control module detects the pump motor is binding or stalled.
- The electronic brake control module detects an open/high resistance on the ground circuit.
- The pump motor has been commanded ON, and OFF for more than five times in the same ignition cycle.
- The electronic brake control module detects a short to ground or an open/high resistance on the B+ circuit.
- If in the Vehicle in Service Mode for an unspecified length of time, the high pressure accumulator may relieve brake pressure enough to set this DTC.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service StabiliTrak message may be displayed.

- The Service Brake Assist message may be displayed.
- The electronic brake control module disables the ABS, the traction control and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Diagnostic Aids

- Check for hydraulic leaks, air in the brake system or incorrect brake bleed.
- Find out from the customer the conditions under which the DTC was set. This information may help duplicate the concern like the specific number of brake pedal applies in a row prior to the fault set.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC C029C is not set.

⇒ **If the DTC is set**

If the DTC is set, refer *DTC C029C, C120C, C129A-C129F, C12B1, or C12F8 on page 5-44*.

⇓ **If the DTC is not set**

3. Perform a hydraulic brake system test, refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*.

⇒ **If the hydraulic brake system test does not pass**

Repair as necessary.

⇓ **If the hydraulic brake system tests normal**

4. Refer to Circuit/System Testing.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the K17 Electronic Brake Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 13 and ground:

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify that a test lamp illuminates between the B+ circuit terminal 1 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

4.1. Vehicle OFF.

4.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

4.1. Vehicle OFF.

4.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the Q5 Brake Pressure Modulator.

⇓ **If the test illuminates**

5. Replace the Q5 Brake Pressure Modulator.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Brake Pressure Modulator Valve Replacement on page 5-76*
- *Control Module References on page 6-3* for electronic brake control module replacement, programming and setup

DTC C012A, C128B, C128E, or C12B2-C12B4

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C012A 00: Brake Master Cylinder Pressure Sensor Malfunction
DTC C128E 00: ABS Master Cylinder Pressure Sensor Raw Offset Error
DTC C012A 01: Brake Master Cylinder Pressure Sensor Low Voltage/Open
DTC C12B3 00: ABS Master Cylinder Pressure Sensor Circuit Short To Battery
DTC C012A 06: Brake Master Cylinder Pressure Sensor Short to Ground or Open
DTC C12B2 00: ABS Master Cylinder Pressure Sensor Circuit Open or Short To Ground
DTC C012A 11: Brake Master Cylinder Pressure Sensor High Input
DTC C128B 00: ABS Master Cylinder Pressure Sensor Offset Error
DTC C012A 0F: Brake Master Cylinder Pressure Sensor Signal Erratic
DTC C12B4 00: ABS Master Cylinder Pressure Sensor Performance

Circuit/System Description

The electronic brake control module uses input from the master cylinder pressure sensor for more accurate control during a vehicle stability enhancement system event. The master cylinder pressure sensor is internal to the brake pressure modulator.

Conditions for Running the DTC

- The brake pedal is not applied.
- Ignition voltage is greater than 10 V.
- Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

C012A 00, C128E 00 or C128B 00

- The Electronic Brake Control Module Learn was not successful.
- The master cylinder pressure sensor raw offset is out of specified range.
- An internal electronic or mechanical fault is detected in the master cylinder pressure sensor.

C012A 01 or C12B3 00

A short to battery is detected on the sensor signal circuit.

C012A 06 or C12B2 00

A short to ground or open is detected on the sensor signal circuit.

C012A 11

Improper learn procedure performed.

C012A 0F or C12B4 00

The signal is erratic and changes to fast.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- A message may be displayed.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Perform the Electronic Brake Control Module Learn procedure with a scan tool.
3. Verify that none of the DTCs listed below are set:
   - DTC C012A
   - DTC C128B
   - DTC C128E
   - DTC C12B2
   - DTC C12B3
   - DTC C12B4

⇒ **If any of the DTCs are set**

3.1. Replace Q5 Brake Pressure Modulator.

3.2. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

⇒ If the DTC sets, replace K17 Electronic Brake Control Module.

⇓ If the DTC does not set

3.3. All OK.

⇓ **If none of the DTCs are set**

4. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Brake Pressure Modulator Valve Replacement on page 5-76*
- *Control Module References on page 6-3* for Electronic Brake Control Module replacement, programming and setup

DTC C012B or C12B6-C12B8

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C012B 01: High Pressure Accumulator Pressure Sensor Short to Battery
DTC C12B7 00: ABS High Pressure Accumulator Pressure Sensor Circuit Short to Battery
DTC C012B 06: High Pressure Accumulator Pressure Sensor Low Voltage/Open
DTC C12B6 00: ABS High Pressure Accumulator Pressure Sensor Circuit Open or Short To Ground
DTC C012B 0F: High Pressure Accumulator Pressure Sensor Signal Erratic
DTC C12B8 00: ABS High Pressure Accumulator Pressure Sensor Erratic

Circuit/System Description

The high pressure accumulator is attached to the brake pressure modulator and provides up to 18,000 kPa (2,600 psi) for use when applying the brakes. The electronic brake control module uses input from the high pressure accumulator sensor for more accurate control during braking and vehicle stability enhancement system event.

Conditions for Running the DTC

- Ignition voltage is greater than 10 V.
- Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

C012B 01 or C12B7 00

A short to battery is detected on the sensor signal circuit.

C012B 06 or C12B6 00

A short to ground or open is detected on signal circuit.

C012B 0F or C12B8 00

The signal is erratic and changes to fast.

Actions Taken when the DTC Sets

- The ABS indicator turns ON.
- A message may be displayed.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The electronic brake control module disables the ABS, the dynamic rear proportioning, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Perform the Electronic Brake Control Module Learn procedure with a scan tool.
3. Verify that none of the DTCs listed below are set:
   - DTC C012B
   - DTC C12B6

- DTC C12B7
- DTC C12B8

⇒ **If any of the DTCs are set**

3.1. Replace the Q5 Brake Pressure Modulator.

3.2. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

⇒ If the DTC sets, replace the K17 Electronic Brake Control Module.

⇓ If the DTC does not set

3.3. All OK.

⇓ **If none of the DTCs are set**

4. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Brake Pressure Modulator Valve Replacement on page 5-76*
- *Control Module References on page 6-3* for Electronic Brake Control Module replacement, programming and setup

DTC C012D, C120A, C128A, C128D, C12BC, C12BD, or C12BE

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C012D 00: Brake Boost Regulation Pressure Sensor Malfunction
DTC C128D 00: ABS Boost Pressure Sensor Raw Offset Error
DTC C012D 01: Brake Boost Regulation Pressure Sensor Short to Battery
DTC C12BD 00: ABS Boost Pressure Sensor Circuit Short To Battery
DTC C012D 06: Brake Boost Regulation Pressure Sensor Low Voltage/Open
DTC C12BC 00: ABS Boost Pressure Sensor Circuit Open or Short To Ground
DTC C012D 11: Brake Boost Regulation Pressure Sensor High Input
DTC C128A 00: ABS Boost Pressure Sensor Offset Error
DTC C012D 5A: Brake Boost Regulation Pressure Sensor Not Plausible
DTC C120A 00: ABS Pump Pressure Performance
DTC C012D 0F: Brake Boost Regulation Pressure Sensor Signal Erratic
DTC C12BE 00: ABS Boost Pressure Sensor Erratic

Circuit/System Description

The electronic brake control module uses input from the boost pressure sensor for more accurate control during brake and vehicle stability enhancement system event. The boost pressure sensor is internal to the brake pressure modulator.

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

C012D 00, C128D 00, C012D 11 or C128A 00

- Internal sensor failure is detected.
- The boost pressure sensor offset is out the of range.

C012D 01 or C12BD 00

A short to battery is detected on the sensor signal circuit.

C012D 06 or C12BC 00

A short to ground or open is detected on the signal circuit.

C012D 5A or C120A 00

The boost pressure is being commanded ON and the pressure is not being achieved.

C012D 0F or C12BE 00

The signal is erratic and changes to fast.

Actions Taken when the DTC Sets

- The ABS indicator turns ON.
- A message may be displayed.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The electronic brake control module disables the ABS, the dynamic rear proportioning, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other electronic brake control module DTCs are set.

⇒ **If any other DTC is set**

Refer to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92*.

⇓ **If no other DTCs are set**

3. Perform the Electronic Brake Control Module Learn procedure with a scan tool.
4. Verify that none of the DTCs listed below are set:
   - DTC C012D
   - DTC C120A
   - DTC C128A,
   - DTC C128D
   - DTC C12BC
   - DTC C12BD
   - DTC C12BE

⇒ **If any of the DTCs are set**

5. Perform a hydraulic brake system test, refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*.

⇒ **If the hydraulic brake system test does not pass**

Repair or replace the applicable component.

⇓ **If the hydraulic brake system tests normal**

6. Replace the Q5 Brake Pressure Modulator.
7. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

⇒ **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

⇓ **If the DTC does not set**

8. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Brake Pressure Modulator Valve Replacement on page 5-76*
- *Control Module References on page 6-3* for Electronic Brake Control Module replacement, programming and setup

DTC C012E or C12FE

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C012E 00: Hydraulic Brake Boost Pressure Loss Malfunction

DTC C12FE 00: ABS Pump Pressure Loss

DTC C012E 12: Hydraulic Brake Boost Pressure Loss Low Input

Circuit/System Description

The boost pressure valve is internal to the brake pressure modulator. The electronic brake control module monitors the boost pressure. The boost valve controls the amount of hydraulic boost required during braking or a vehicle stability event.

When a boost fault condition is detected, the boost control will continue applying as much pressure as possible until boost pressure is no longer available.

Conditions for Running the DTC

- Ignition voltage is greater than 10 V.
- Brake pedal was applied.

Conditions for Setting the DTC

- A boost valve fault.
- Brake system hydraulic leak.
- Excessive brake pedal applies.
- Improper brake hydraulic system bleed.
- Master cylinder pressure is greater than boost pressure.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- A message may be displayed.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Diagnostic Aids

Excessive brake pedal applies (10 or more applies in 30 seconds) may cause the DTC to set.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

Note: The 12 V battery must be able to maintain a charge during this brake sensor performance procedure. It is recommended that a charger/maintainer or equivalent be used to maintain proper battery voltage during this procedure.

1. Vehicle in Service Mode with the transmission in PARK.

   Note: Do not depress the brake pedal during the Electronic Brake Control Module Learn.

2. Perform the Electronic Brake Control Module Learn procedure with a scan tool.

   Note: To ensure the complete brake modulator and high pressure accumulator pressure relief procedure is allowed to occur; the brake controller must see 1 pedal apply with the propulsion system enabled, followed by a proper shutdown without applying the brake pedal.

3. Vehicle ON, apply and release the brake pedal.

   Note: Vehicle OFF, without applying the brake pedal ensure the brake modulator and high pressure accumulator pressure relief occurs. This process will take approximately 1-3 minutes.

4. Vehicle OFF, without applying the brake pedal.
5. Remove the remote keyless entry transmitter and close all of the vehicle doors. Wait approximately 1-3 minutes until the brake modulator and the high pressure accumulator pressure relief is complete and the vehicle powers down.
6. Vehicle in Service Mode, brakes not applied.
7. Verify the scan tool parameters listed below are within the specified range:
   - Brake Controls Brake Pedal Position Sensor 5 V Supply Voltage – Between 4.75–5.25 V
   - Brake Controls Brake Pedal Position Sensor Circuit 1 – Between 1.4–1.7 V
   - Brake Controls Brake Pedal Position Sensor Circuit 2 – Between 58–78%

⇒ **If any of the parameters are not within the specified range**

Refer to *DTC C029C, C120C, C129A-C129F, C12B1, or C12F8 on page 5-44*

⇓ **If all of the parameters are within the specified range**

8. Verify the scan tool parameters listed below are less the specified range:
   - Brake Master Cylinder Pressure Sensor – Less than 100 kPa (15 psi)
   - Brake Pressure Sensor – Less than 100 kPa (15 psi)
   - High Pressure Accumulator Sensor – Less than 800 kPa (116 psi)

⇒ **If any parameter is greater than the specified range**

Replace the Q5 Brake Pressure Modulator.

⇓ **If all of the parameters are less than the specified range**

9. Perform a hydraulic brake system test, refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*

⇒ **If the hydraulic brake system test does not pass**

Repair or replace the applicable component.

⇓ **If the hydraulic brake system tests normal**

10. Replace the Q5 Brake Pressure Modulator.
11. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

⇒ **If the DTC sets**

Replace the K17 Electronic Brake Control Module

⇓ **If the DTC does not set**

12. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Brake Pressure Modulator Valve Replacement on page 5-76*
- *Control Module References on page 6-3* for Electronic Brake Control Module replacement, programming and setup

DTC C012F, C12A7, or C12DD

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C012F 00: Brake Boost Solenoid Valve Circuit

DTC C12A7 00: ABS Boost Valve Solenoid Circuit Performance

DTC C12DD 00: ABS Brake Boost Solenoid Valve Circuit Shorted

Circuit/System Description

The brake boost solenoid valve is used to control the amount of brake fluid flow from the high pressure accumulator, which provides brake assist and an improved brake pedal feel. The brake boost solenoid valve is an internal part of the brake pressure modulator.

Conditions for Running the DTC

- Ignition voltage is greater than 10 V.
- The Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

Solenoid feedback current is greater than 25% of commanded current.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- A message may be displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

Note: The 12 V battery must be able to maintain a charge during this brake sensor performance procedure. It is recommended that a charger/maintainer or equivalent be used to maintain proper battery voltage during this procedure.

1. Vehicle in Service Mode with the transmission in PARK.

   Note: Do not depress the brake pedal during the Electronic Brake Control Module Learn.

2. Perform the Electronic Brake Control Module Learn procedure with a scan tool.

   Note: To ensure the complete brake modulator and high pressure accumulator pressure relief procedure is allowed to occur; the brake controller must see 1 pedal apply with the propulsion system enabled, followed by a proper shutdown without applying the brake pedal.

3. Vehicle ON, apply and release the brake pedal.

   Note: Vehicle OFF, without applying the brake pedal ensure the brake modulator and high pressure accumulator pressure relief occurs. This process will take approximately 1-3 minutes.

4. Vehicle OFF, without applying the brake pedal.
5. Remove the remote keyless entry transmitter and close all of the vehicle doors. Wait approximately 1-3 minutes until the brake modulator and the high pressure accumulator pressure relief is complete and the vehicle powers down.
6. Vehicle in Service Mode, brakes not applied.

7. Verify the scan tool parameters listed below are within the specified range:
   - Brake Controls Brake Pedal Position Sensor 5 V Supply Voltage – Between 4.75–5.25 V
   - Brake Controls Brake Pedal Position Sensor Circuit 1 – Between 1.4–1.7 V
   - Brake Controls Brake Pedal Position Sensor Circuit 2 – Between 58–78%

⇒ **If any parameter is not within the specified range**

Refer to Circuit/System Testing.

⇓ **If all parameters are within the specified range**

8. Verify the scan tool parameters listed below are less the specified range:
   - Brake Master Cylinder Pressure Sensor – Less than 100 kPa (15 psi)
   - Brake Pressure Sensor – Less than 100 kPa (15 psi)
   - High Pressure Accumulator Sensor – Less than 800 kPa (116 psi)

⇒ **If any parameter is greater than the specified range**

Replace the Q5 Brake Pressure Modulator.

⇓ **If all parameters are less than the specified range**

9. Perform a hydraulic brake system test, refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*

⇒ **If the hydraulic brake system test does not pass**

Repair as necessary.

⇓ **If the hydraulic brake system tests normal**

10. Replace the Q5 Brake Pressure Modulator.
11. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

⇒ **If the DTC sets**

K17 Electronic Brake Control Module.

⇓ **If the DTC does not set**

12. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Brake Pressure Modulator Valve Replacement on page 5-76*
- *Control Module References on page 6-3* for Electronic Brake Control Module replacement, programming and setup

DTC C0161

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C0161 04: Antilock Braking System Brake Pedal Position Sensor Circuit Open

DTC C0161 0E: Antilock Braking System Brake Pedal Position Sensor Circuit Low Resistance

Circuit/System Description

The body control module monitors the brake pedal position sensor and sends a serial data message to the electronic brake control module when the brake pedal is applied. The electronic brake control module compares the correlation between the brake pedal positions and the brake control brake pedal position sensor to sense the driver's application of the brake pedal.

Conditions for Running the DTC

C0161 04

- Vehicle ON
- The brake pedal is applied.
- The ignition voltage is greater than 10 V.

C0161 0E

- Vehicle ON
- The ignition voltage is greater than 10 V.
- The vehicle speed is greater than 15 km/h (9 MPH).
- The accelerator pedal position is greater than 20 %.

Conditions for Setting the DTC

C0161 04

The brake pedal position sensor signal is not applied while the brake control brake pedal position sensor indicates the brake pedal is applied.

C0161 0E

The brake control brake pedal position sensor signal is showing the brakes applied while the vehicle speed is greater than 15 km/h (9 MPH).

Action Taken When the DTC Sets

A driver information center message and/or a warning indicator will not be displayed.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Diagnostic Aids

- DTC C0161 may set if the brake pedal is applied while accelerating.
- Diagnose all other stop lamp DTCs or Symptoms prior to performing this diagnostic procedure.

Reference Information

Schematic Reference

- *Antilock Brake System Schematics on page 5-6*
- *Exterior Lights Schematics on page 4-70*

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3

Circuit/System Verification

1. Vehicle ON.
2. Verify that DTC C0277 or C0890 is not set.

⇒ **If either DTC is set**

Refer to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92*.

⇓ **If either DTC is not set**

3. Verify the brake pedal position sensor or the brake pedal is not binding causing residual brake pressure to be detected.

⇒ **If a condition is found**

Repair or replace the applicable component.

⇓ **If a condition is not found**

4. Verify the scan tool electronic brake control module Brake Pedal Position Sensor Signal parameter changes between Applied and Released when applying and releasing the brake pedal.

⇒ **If the parameter does not change**

Refer to *Symptoms - Lighting on page 4-141*.

⇓ **If the parameter changes**

5. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for Electronic Brake Control Module replacement, programming and setup

DTC C0186, C0187, C0196, or C0287

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C0186: Lateral Acceleration Sensor Signal (Inflatable Restraint Sensing and Diagnostic Module)

DTC C0187: Lateral Acceleration Sensor Circuit (Electronic Brake Control Module)

DTC C0196: Yaw Rate Signal (Inflatable Restraint Sensing and Diagnostic Module and/or Electronic Brake Control Module)

DTC C0287: Longitudinal Acceleration Sensor Signal (Inflatable Restraint Sensing and Diagnostic Module and/or Electronic Brake Control Module)

For symptom byte information refer to *Symptom Byte List on page 6-117*.

Circuit/System Description

The yaw rate, lateral acceleration and longitudinal acceleration sensors are combined into one multi-axis acceleration sensor, internal to the inflatable restraint sensing and diagnostic module. The multi-axis acceleration sensor communicates with the electronic brake control module via serial data. The electronic brake control module activates the stability control function depending on the multi-axis acceleration sensor input. The inflatable restraint sensing and diagnostic module uses the multi-axis acceleration sensor to determine if the vehicle is in a roll over or near collision incident.

Conditions for Running the DTC

Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

C0186 00 or C0187 5A

- The lateral acceleration signal offset is out of the specified range.
- An internal fault in multi-axis acceleration sensor will set this DTC.
- Improperly mounted or loose inflatable restraint sensing and diagnostic module may set this DTC.
- The lateral acceleration signal is not plausible with the yaw rate, the steering wheel angle signal and the vehicle speed.

C0196 5A

- The yaw rate signal is out of the specified range.
- An internal fault in multi-axis acceleration sensor may set DTC C0196 5A.
- Improperly mounted or loose inflatable restraint sensing and diagnostic module may set this DTC.
- The yaw rate signal is not plausible with the lateral acceleration signal, the steering wheel angle sensor signal and the vehicle speed.

C0196 00

The yaw rate signal is out of the specified range.

C0287 00

The longitudinal acceleration signal is out of the specified range.

C0287 5A

- An Internal fault in multi-axis acceleration sensor will set this DTC.
- The longitudinal acceleration signal is not plausible with the vehicle acceleration.

Action Taken When the DTC Sets

- The Air Bag Indicator turns ON.
- The traction/stability control indicator turns ON.
- The electric brake control module disables the stability control and the hill start assist for the duration of the ignition cycle.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Verify DTC C0186, C0196, or C0287 is not set in the K36 Inflatable Restraint Sensing and Diagnostic Module.

⇒ **If any of the DTCs are set**

Perform the *Vehicle Yaw Sensor Learn on page 5-90*.

⇓ **If none of the DTCs are set**

2. Verify DTC C0187, C0196, or C0287 is not set in the K17 Electronic Brake Control Module.

⇒ **If any of the DTCs are set**

2.1. Replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

2.2. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

⇒ If the DTC sets, replace the K17 Electronic Brake Control Module.

⇓ If the DTC does not set

2.3. All OK.

⇓ **If none of the DTCs are set**

3. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for Electronic Brake Control Module or Inflatable Restraint Sensing and Diagnostic Module replacement, programming and setup

DTC C0201

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C0201 04: Antilock Braking System Enable Relay Primary Circuit Open
DTC C12E6 00: ABS Switch Circuit Open
DTC C0201 0E: Antilock Braking System Enable Relay Primary Circuit Low Resistance
DTC C12E7 00: ABS Switch Circuit Shorted

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	C0201 04	C0201 04	—	C0201 0E
Ground Terminal 13	—	C056D 00, C12DA 00, C12D7 00	—	—
Ground Terminal 38	—	U0121 00, U0129 00, U1833 00	—	—

Circuit/System Description

Battery positive voltage is supplied to the electronic brake control module at all times through a 30 A fuse located in the underhood fuse block. The electronic brake control module uses this voltage to power the solenoid valves which are integral part of the brake pressure modulator. When the ABS or traction control system operation is required the electronic brake control module activates the solenoid relay and turns the solenoid valves ON.

Conditions for Running the DTC

C0201 04 or C12E6 00

- Ignition voltage is greater than 10 V.
- The solenoid relay is commanded ON.

C0201 0E or C12E7 00

- Ignition voltage is greater than 10 V.
- The solenoid relay is commanded OFF.

Conditions for Setting the DTC

C0201 04 or C12E6 00

- The electronic brake control module detects an open in the B+ circuit.
- The engine control module detects the traction control power switch circuit is open.

C0201 0E or C12E7 00

- The electronic brake control module detects an internal power switch shorted.
- The engine control module detects the traction control power switch circuit is shorted.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The Service StabiliTrak message is displayed.
- The traction/stability control indicator turns ON.
- The electronic brake control module disables the traction control and the electronic stability control for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF all vehicle systems OFF, disconnect the harness connector at the K17 Electronic Brake Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminals listed below and ground:
   - Terminal 13
   - Terminal 38

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode, verify a test lamp illuminates between the B+ circuit terminal 25 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

3.1. Vehicle OFF, remove test lamp.

3.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

3.1. Vehicle OFF, remove test lamp.

3.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K17 Electronic Brake Control Module.

⇓ **If the test lamp illuminates**

4. Replace the K17 Electronic Brake Control Module.
5. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

⇒ **If the DTC sets**

Replace the Q5 Brake Pressure Modulator.

⇓ **If the DTC does not set**

6. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Brake Pressure Modulator Valve Replacement on page 5-76*
- *Control Module References on page 6-3* for electronic brake control module replacement, programming and setup

DTC C0242 or P0856

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C0242 00: Engine Control Module Indicated Traction Control Malfunction

DTC P0856: Traction Control Torque Request Circuit

Circuit/System Description

The electronic brake control module and the engine control module simultaneously control the traction control. The electronic brake control module sends a serial data message to the engine control module requesting torque reduction. When certain engine control module DTCs are set, the engine control module will not be able to perform the torque reduction for traction control. A serial data message is sent to the electronic brake control module indicating that traction control is not allowed.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

The engine control module diagnoses a condition preventing the engine control portion of the traction control function and sends a serial data message to the electronic brake control module indicating that torque reduction is not allowed.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The MIL indicator may be on or flashing.
- The traction control/stability control indicator turns ON.
- The Service StabiliTrak message is displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set except for C0242 or P0856.

⇒ **If any other DTCs are set**

Refer to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92*.

⇓ **If no other DTCs are set**

3. Replace the K20 Engine Control Module.
4. Verify that DTC C0242 or P0856 does not set while operating the vehicle under the Conditions for Running the DTC. You may also operate the vehicle under the conditions that you observed from the Freeze Frame/Failure Records data.

⇒ **If DTC C0242 or P0856 sets**

Replace the K17 Electronic Brake Control Module.

⇓ **If DTC C0242 or P0856 does not set**

5. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for Electronic Brake Control Module or Engine Control Module replacement, programming and setup

DTC C0245, C122E

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C0245 00: Wheel Speed Sensor Frequency Error
DTC C122E: Tire Size Mismatch

Circuit/System Description

The wheel speeds are detected by active wheel speed sensors. Each wheel speed sensor receives ignition voltage from the electronic brake control module and provides an alternating current square wave signal to the electronic brake control module. As the wheel spins, the module uses the frequency of the square wave signal to calculate the wheel speed.

Conditions for Running the DTC

- Vehicle On or Vehicle in Service Mode.
- Ignition voltage is greater than 10 V.
- Vehicle must be moving at a speed less than 14.5 km/h (9 MPH).
- No wheel speed sensor faults are set.
- Brake is not applied.
- Vehicle is not cornering.
- No wheel spinning is detected.

Conditions for Setting the DTC

- Missing tooth or teeth on the wheel speed sensor tone ring.
- The wheel speed differences between one wheel and the others is greater than 25 percent.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information center.
- The electronic brake control module disables the ABS, the dynamic rear proportioning, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Diagnostic Aids

- A faulty wheel speed sensor will not set this DTC.
- A vehicle using a space saver spare will not set this DTC.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Verify that all tires have the proper air pressure.

⇒ **If not the proper air pressure**

Adjust the air pressure in all tires to the stated cold air pressure as identified on the tire placard or specification.

⇓ **If the proper air pressure**

2. Verify that all tires are of uniform size and matching brand.

⇒ **If not of uniform size or matching brand**

2.1. Replace the mis-sized or non-matching brand tire.

2.2. Vehicle in Service Mode.

2.3. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

⇒ If the DTC is set, replace the K17 Electronic Brake Control Module.

⇓ If the DTC does not set

2.4. All OK.

⇓ **If all tires are of uniform size or matching brand**

3. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for Electronic Brake Control Module replacement, programming and setup

DTC C0256, C12E6, or C12E7

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C0256 04: Valve Relay Primary Circuit Open
DTC C12E6 00: ABS Switch Circuit Open
DTC C0256 0E: Valve Relay Primary Circuit Low Resistance
DTC C12E7 00: ABS Switch Circuit Shorted

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	C0256 04, C12E6 00	C0256 04, C12E6 00	—	—
Ground Terminal 13	—	C056D 00, C12DA 00, C12D7 00	—	—
Ground Terminal 38	—	U0121 00, U0129 00, U1833 00	—	—

Circuit/System Description

Battery positive voltage is supplied to the electronic brake control module at all times through a 50 A fuse located in the underhood fuse block. The electronic brake control module uses this voltage to power the pump motor. The pump motor is an integral part of the brake pressure modulator, while the pump motor relay is integral to the electronic brake control module. The pump motor relay is not engaged during normal system operation. When the ABS or the action control system operation is required the electronic brake control module activates the pump motor relay and turns the pump motor ON.

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

C0256 04 or C12E6 00

- The electronic brake control module detects an open in the B+ circuit.
- The engine control module detects the ABS brake switch circuit is open.

C0256 0E or C12E7 00

- The engine control module detects the ABS switch circuit is shorted.
- The electronic brake control module detects an internal power switch shorted.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service StabiliTrak message may be displayed.
- The Service Brake Assist message may be displayed.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the ABS pump motor turns On when commanding the ABS Motor On with a scan tool.

⇒ **If the pump motor does not turn On**

Refer to Circuit/System Testing.

⇓ **If the pump motor turns On**

3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the K17 Electronic Brake Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal listed below and ground:
   - Terminal 13
   - Terminal 38

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

4.1. Vehicle OFF, remove the test lamp.

4.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

4.1. Vehicle OFF, remove the test lamp.

4.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the Q5 Brake Pressure Modulator.

⇓ **If the test lamp illuminates**

5. Replace the K17 Electronic Brake Control Module.
6. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

⇒ **If the DTC sets**

Replace the Q5 Brake Pressure Modulator.

⇓ **If the DTC does not set**

7. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Brake Pressure Modulator Valve Replacement on page 5-76*
- *Control Module References on page 6-3* for electronic brake control module replacement, programming and setup

DTC C0294, C120C, or C12F8

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C0294 00: Brake Switch and Brake Pedal Position Sensor Correlation Malfunction
DTC C120C 00: Brake Pedal Position Sensor 4 Plausibility
DTC C12F8 00: Brake Pedal Position Sensor 3 Plausibility

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	C0110 00, C0880 00, C0880 02, C029C 5A, C120F 00, C12E0. 00, C12E5 00	C0110 00, C029C 03, C129A 00, C029C 07, C029C 5A, C129E 00, C12E0 00	C0110 00, C0880 00, C029C 5A, C12E0 00, C12E5 00	C12B1 00, C12F8 00
Brake Control Brake Pedal Position Sensor Circuit 1 Terminal 4	C029C 03, C129A 00	C029C 03, C129A.00	C0110 00, C0880 00, C029C 5A, C12E0 00, C12E5 00	C12B1 00, C12F8 00
Brake Control Brake Pedal Position Sensor Circuit 2 Terminal 6	C029C 03, C129D 00	C029C 07, C129E 00	C0110 00, C029C 07, C129E 00, C12E0 00	C12B1 00, C12F8 00
Low Reference	—	C0110 00, C0294 00, C029C 07, C029C 5A, C129E 00, C12E0 00, C12F8 00	—	—

Circuit/System Description

The electronic brake control module uses input from the brake control brake pedal position sensor and the brake pedal position sensor to determine when the brake pedal is being applied and with how much force. These inputs are used to determine the driver's braking intent which is used to control the amount of pressure applied to the wheels.

Conditions for Running the DTC

- Ignition voltage is greater than 10 V.
- Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

- The electronic brake control module detects an open in the low reference circuit.
- The electronic brake control module detects that the two signal circuits do not match each other.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service StabiliTrak message may be displayed.
- The Service Brake Assist message may be displayed.
- The electronic brake control module disables the ABS, the dynamic rear proportioning, the traction control system and the electronic stability control for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

Note: The 12 V battery must be able to maintain a charge during this brake sensor performance procedure. It is recommended that a charger/maintainer or equivalent be used to maintain proper battery voltage during this procedure.

1. Vehicle in Service Mode with the transmission in PARK.

   Note: Do not depress the brake pedal during the Electronic Brake Control Module Learn.
2. Perform the Electronic Brake Control Module Learn procedure with a scan tool.

   Note: To ensure the complete brake modulator and high pressure accumulator pressure relief procedure is allowed to occur; the brake controller must see 1 pedal apply with the propulsion system enabled, followed by a proper shutdown without applying the brake pedal.
3. Vehicle ON, apply and release the brake pedal.

   Note: Vehicle OFF, without applying the brake pedal ensure the brake modulator and high pressure accumulator pressure relief occurs. This process will take approximately 1-3 minutes.
4. Vehicle OFF, without applying the brake pedal,
5. Remove the remote keyless entry transmitter and close all of the vehicle doors. Wait approximately 1-3 minutes until the brake modulator and the high pressure accumulator pressure relief is complete and the vehicle powers down.
6. Vehicle in Service Mode, brakes not applied.
7. Verify the scan tool parameters listed below are within the specified range:
   - Brake Controls Brake Pedal Position Sensor 5 V Supply Voltage – Between 4.75–5.25 V.
   - Brake Controls Brake Pedal Position Sensor Circuit 1 – Between 1.4–1.7 V
   - Brake Controls Brake Pedal Position Sensor Circuit 2 – Between 58–78%

⇒ **If any parameter is not within the specified range**

Refer to Circuit/System Testing.

⇓ **If all parameters are within the specified range**

8. Verify the scan tool parameters listed below are less the specified range:
   - Brake Master Cylinder Pressure Sensor – Less than 100 kPa (15 psi)
   - Brake Pressure Sensor – Less than 100 kPa (15 psi)
   - High Pressure Accumulator Sensor – Less than 800 kPa (116 psi)

⇒ **If any parameter is greater than the specified range**

Replace the Q5 Brake Pressure Modulator.

⇓ **If all parameters are less than the specified range**

9. Perform a hydraulic brake system test, refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*.

⇒ **If the hydraulic brake system test does not pass**

Repair or replace the applicable component.

⇓ **If the hydraulic brake system tests normal**

10. Replace the Q5 Brake Pressure Modulator.
11. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

⇒ **If the DTC is set**

Replace the K17 Electronic Brake Control Module.

⇓ **If the DTC is not set**

12. All OK.

Circuit/System Testing

1. Perform the brake hydraulic check, refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*.
2. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B201 Brake Control Brake Pedal Position Sensor. It may take up to 2 min for all vehicle systems to power down.
3. Test for less than 5 Ω between the low reference circuit terminal 1 and ground.

⇒ **If 5 Ω or greater**

3.1. Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.

3.2. Test for less than 2 Ω in the low reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K17 Electronic Brake Control Module.

⇓ **If less than 5 Ω**

4. Vehicle in Service Mode.

5. Test for 4.8–5.2 V between the 5 V reference circuit terminal 5 and ground.

⇒ **If less than 4.8 V**

5.1. Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.

5.2. Test for infinite resistance between the 5 V reference circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

5.3. Test for less than 2 Ω in the 5 V reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K17 Electronic Brake Control Module.

⇒ **If greater than 5.2 V**

5.1. Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, vehicle in service mode.

5.2. Test for less than 1 V between the 5 V reference circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K17 Electronic Brake Control Module.

⇓ **If between 4.8–5.2 V**

6. Verify the scan tool Brake Controls Brake Pedal Position Sensor Circuit 1 parameter is less than 1 V.

⇒ **If 1 V or greater**

6.1. Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, vehicle in service mode.

6.2. Test for less than 1 V between the signal circuit terminal 4 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K17 Electronic Brake Control Module.

⇓ **If less than 1 V**

7. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the 5 V reference circuit terminal 5.

8. Verify the scan tool Brake Controls Brake Pedal Position Sensor Circuit 1 parameter is greater than 4.5 V.

⇒ **If 4.5 V or less**

8.1. Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.

8.2. Test for infinite resistance between the signal circuit terminal 4 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

8.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K17 Electronic Brake Control Module.

⇓ **If greater than 4.5 V**

9. Verify the scan tool Brake Controls Brake Pedal Position Sensor Circuit 2 parameter is greater than 80%.

⇒ **If 80% or less**

9.1. Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.

9.2. Test for infinite resistance between the signal circuit terminal 6 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K17 Electronic Brake Control Module.

⇓ **If greater than 80%**

10. Install a 3 A fused jumper wire between the signal circuit terminal 6 and the low reference circuit terminal 1.

11. Verify the scan tool Brake Controls Brake Pedal Position Sensor Circuit 2 is less than 10%.

⇒ **If 10% or greater**

11.1. Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, vehicle in service mode.

11.2. Test for less than 1 V between the signal circuit terminal 6 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

11.3. Vehicle OFF.

11.4. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K17 Electronic Brake Control Module.

⇓ **If less than 10%**

12. Replace the B201 Brake Control Brake Pedal Position Sensor.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Brake Pedal Position Sensor Replacement (Travel Sensor) on page 4-170* or *Brake Pedal Position Sensor Replacement (Apply Sensor) on page 4-171*
- *Control Module References on page 6-3* for electronic brake control module replacement, programming and setup

DTC C0299 or C12FF

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C0299 00: Brake Booster Performance Malfunction

DTC C12FF 00: Electronic Brake Control Module Non-Volatile RAM Malfunction

DTC C0299 31: Brake Booster Performance Internal Checksum Error

Circuit/System Description

The electronic brake control module uses inputs from the brake master cylinder piston position sensor and the brake pedal position sensor to determine when the brake pedal is being applied and with how much force. These inputs determine the driver's braking intent which is used to control the amount of pressure applied to the wheels.

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

- The brake pedal is sensed as applied for 6 minutes.
- The vehicle speed is greater than 21 km/h (13 MPH).

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- A message may be displayed.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The electronic brake control module disables the ABS, the dynamic rear proportioning, the traction control system and the electronic stability control for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

Note: The 12 V battery must be able to maintain a charge during this brake sensor performance procedure. It is recommended that a charger/maintainer or equivalent be used to maintain proper battery voltage during this procedure.

1. Vehicle in Service Mode with the transmission in PARK.

   Note: Do not depress the brake pedal during the Electronic Brake Control Module Learn.

2. Perform the Electronic Brake Control Module Learn procedure with a scan tool.

   Note: To ensure the complete brake modulator and high pressure accumulator pressure relief procedure is allowed to occur; the brake controller must see 1 pedal apply with the propulsion system enabled, followed by a proper shutdown without applying the brake pedal.

3. Vehicle ON, apply and release the brake pedal.

   Note: Vehicle OFF, without applying the brake pedal ensure the brake modulator and high pressure accumulator pressure relief occurs. This process will take approximately 1-3 minutes.

4. Vehicle OFF, without applying the brake pedal, remove the remote keyless entry transmitter and close all of the vehicle doors.
5. Remove the remote keyless entry transmitter and close all of the vehicle doors. Wait approximately 1-3 minutes until the brake modulator and the high pressure accumulator pressure relief is complete and the vehicle powers down.
6. Vehicle in Service Mode, brakes not applied.

7. Verify the scan tool parameters listed below are within the specified range:
   - Brake Controls Brake Pedal Position Sensor 5 V Supply Voltage – Between 4.75–5.25 V.
   - Brake Controls Brake Pedal Position Sensor Circuit 1 – Between 1.4–1.7 V
   - Brake Controls Brake Pedal Position Sensor Circuit 2 – Between 58–78%

⇒ **If any parameter is not within the specified range**

Refer to *DTC C029C, C120C, C129A-C129F, C12B1, or C12F8 on page 5-44*

⇓ **If all parameters are within the specified range**

8. Verify the scan tool parameters listed below are less the specified range:
   - Brake Master Cylinder Pressure Sensor – Less than 100 kPa (15 psi)
   - Brake Pressure Sensor – Less than 100 kPa (15 psi)
   - High Pressure Accumulator Sensor – Less than 800 kPa (116 psi)

⇒ **If any parameter is greater than the specified range**

Replace the Q5 Brake Pressure Modulator.

⇓ **If all parameters are less than the specified range**

9. Perform a hydraulic brake check, refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*

⇒ **If the hydraulic brake system test does not pass**

Repair or replace the applicable component.

⇓ **If the hydraulic brake system tests normal**

10. Replace the Q5 Brake Pressure Modulator.
11. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

⇒ **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

⇓ **If the DTC does not set**

12. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Brake Pressure Modulator Valve Replacement on page 5-76*
- *Control Module References on page 6-3* for Electronic Brake Control Module replacement, programming and setup

DTC C029C, C120C, C129A-C129F, C12B1, or C12F8

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C029C 03: Brake Control Brake Pedal Position Sensor Circuit Low Voltage
DTC C129A 00: Brake Pedal Position Sensor 3 Circuit Low Input
DTC C129D 00: Brake Pedal Position Sensor 4 Circuit Low Input
DTC C029C 07: Brake Control Brake Pedal Position Sensor Circuit High Voltage
DTC C129B 00: Brake Pedal Position Sensor 3 Circuit High Input
DTC C129E 00: Brake Pedal Position Sensor 4 Circuit High Input
DTC C029C 1A: Brake Control Brake Pedal Position Sensor Circuit Performance Bias Level Out of Range
DTC C129C 00: Brake Pedal Position Sensor 3 Circuit Calibration
DTC C129F 00: Brake Pedal Position Sensor 4 Circuit Calibration
DTC C029C 5A: Brake Control Brake Pedal Position Sensor Circuit Not Plausible
DTC C12B1 00: ABS Master Cylinder Pressure Sensor and Brake Pedal Position Sensor Not Plausible
DTC C12F8 00: Brake Pedal Position Sensor 3 Plausibility
DTC C120C 00: Brake Pedal Position Sensor 4 Plausibility

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	C0110 00, C0880 00, C0880 02, C029C 5A, C120F 00, C12E0 00, C12E5 00	C0110 00, C029C 03, C129A 00, C029C 07, C029C 5A, C129E 00, C12E0 00	C0110 00, C0880 00, C029C 5A, C12E0 00, C12E5 00	C12B1 00, C12F8 00
Brake Control Brake Pedal Position Sensor Circuit 1 Terminal 4	C029C 03, C129A 00	C029C 03, C129A 00	C0110 00, C0880 00, C029C 5A, C12E0 00, C12E5 00	C12B1 00, C12F8 00
Brake Control Brake Pedal Position Sensor Circuit 2 Terminal 6	C029C 03, C129D 00	C029C 07, C129E 00	C0110 00, C029C 07, C129E 00, C12E0 00	C12B1 00, C12F8 00
Low Reference	—	C0110 00, C0294 00, C029C 07, C029C 5A, C129E 00, C12E0 00, C12F8 00	—	C12B1 00, C12F8 00

Circuit/System Description

The electronic brake control module uses inputs from the electronic brake control brake pedal position sensor to determine when the brake is applied and how much force is used. The electronic brake control module monitors when the drivers foot is on the brake and locks the offset. The offset is locked when three out of the four inputs indicate the brake pedal is applied. The four inputs are brake pedal travel 1, brake pedal travel 2, master cylinder pressure sensor, and the brake pedal position sensor. These inputs are used to determine the driver's braking intent which is used to the control amount of pressure applied to the wheels.

Conditions for Running the DTC

- Vehicle in Service Mode.
- Ignition voltage is greater than 10 V.

Conditions for Setting the DTC

C029C 00

- The brake pedal position sensor voltage is out of range.
- The electronic brake control module detects improper offset learn.
- Foot on brake pedal during the electronic brake control module learn procedure.

C029C 03, C129A 00, or C129D 00

The electronic brake control module detects voltage below threshold on signal circuit.

C029C 07, C129B 00, or C129E 00

The electronic brake control module detects voltage above threshold on signal circuit.

C029C 1A, C129C 00, or C129F 00

The electronic brake control pedal position sensor learn procedure has not been performed.

C029C 5A, C12B1 00, C12F8 00, or C120C 00

- The electronic brake control module detects the brake pressure is high when the electronic brake control pedal position sensor is reading low travel.
- The electronic brake control module detects the brake pressure is low when the electronic brake control pedal position sensor is reading high travel.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service StabiliTrak message may be displayed.
- The Service Brake Assist message may be displayed.
- The electronic brake control module disables the ABS, the dynamic rear proportioning, the traction control system and the electronic stability control for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting he DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

Note: The 12 V battery must be able to maintain a charge during this brake sensor performance procedure. It is recommended that a charger/ maintainer or equivalent be used to maintain proper battery voltage during this procedure.

1. Vehicle in Service Mode with the transmission in PARK.

   Note: Do not depress the brake pedal during the Electronic Brake Control Module Learn.
2. Perform the Electronic Brake Control Module Learn procedure with a scan tool.

   Note: To ensure the complete brake modulator and high pressure accumulator pressure relief procedure is allowed to occur; the brake controller must see 1 pedal apply with the propulsion system enabled, followed by a proper shutdown without applying the brake pedal.
3. Vehicle ON, apply and release the brake pedal.

   Note: Vehicle OFF, without applying the brake pedal ensure the brake modulator and high pressure accumulator pressure relief occurs. This process will take approximately 1-3 minutes.
4. Vehicle OFF, without applying the brake pedal.
5. Remove the remote keyless entry transmitter and close all of the vehicle doors. Wait approximately 1-3 minutes until the brake modulator and the high pressure accumulator pressure relief is complete and the vehicle powers down.
6. Vehicle in Service Mode, brakes not applied.
7. Verify the scan tool parameters listed below are within the specified range:
   - Brake Controls Brake Pedal Position Sensor 5 V Supply Voltage – Between 4.75–5.25 V
   - Brake Controls Brake Pedal Position Sensor Circuit 1 – Between 1.4–1.7 V
   - Brake Controls Brake Pedal Position Sensor Circuit 2 – Between 58–78%

⇒ **If any parameter is not within the specified range**

Refer to Circuit/System Testing.

⇓ **If all parameters are within the specified range**

8. Verify the scan tool parameters listed below are less the specified range:
   - Brake Master Cylinder Pressure Sensor – Less than 100 kPa (15 psi)
   - Brake Pressure Sensor – Less than 100 kPa (15 psi)
   - High Pressure Accumulator Sensor – Less than 800 kPa (116 psi)

⇒ **If any parameter is greater than the specified range**

Replace the Q5 Brake Pressure Modulator.

⇓ **If all parameters are less than the specified range**

9. Perform a hydraulic brake system test, refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*.

⇒ **If the hydraulic brake system test does not pass**

Repair or replace the applicable component.

⇓ **If the hydraulic brake system tests normal**

10. Replace the Q5 Brake Pressure Modulator.
11. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

⇒ **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

⇓ **If the DTC does not set**

12. All OK.

Circuit/System Testing

1. Perform the hydraulic brake check, refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*.
2. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B201 Brake Control Brake Pedal Position Sensor. It may take up to 2 min for all vehicle systems to power down.
3. Test for less than 5 Ω between the low reference circuit terminal 1 and ground.

⇒ **If 5 Ω or greater**

3.1. Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.

3.2. Test for less than 2 Ω in the low reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K17 Electronic Brake Control Module.

⇓ **If less than 5 Ω**

4. Vehicle in Service Mode.
5. Test for 4.8–5.2 V between the 5 V reference circuit terminal 5 and ground.

⇒ **If less than 4.8 V**

5.1. Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.

5.2. Test for infinite resistance between the 5 V reference circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

5.3. Test for less than 2 Ω in the 5 V reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K17 Electronic Brake Control Module.

⇒ **If greater than 5.2 V**

5.1. Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, vehicle in service mode.

5.2. Test for less than 1 V between the 5 V reference circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K17 Electronic Brake Control Module.

⇓ **If between 4.8–5.2 V**

6. Verify the scan tool Brake Controls Brake Pedal Position Sensor Circuit 1 parameter is less than 1 V.

⇒ **If 1 V or greater**

6.1. Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, vehicle in service mode.

6.2. Test for less than 1 V between the signal circuit terminal 4 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K17 Electronic Brake Control Module.

⇓ **If less than 1 V**

7. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the 5 V reference circuit terminal 5.

8. Verify the scan tool Brake Controls Brake Pedal Position Sensor Circuit 1 parameter is greater than 4.5 V.

⇒ **If 4.5 V or less**

8.1. Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.

8.2. Test for infinite resistance between the signal circuit terminal 4 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

8.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K17 Electronic Brake Control Module.

⇓ **If greater than 4.5 V**

9. Verify the scan tool Brake Controls Brake Pedal Position Sensor Circuit 2 parameter is greater than 80%.

⇒ **If 80% or less**

9.1. Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.

9.2. Test for infinite resistance between the signal circuit terminal 6 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K17 Electronic Brake Control Module.

⇓ **If greater than 80%**

10. Install a 3 A fused jumper wire between the signal circuit terminal 6 and the low reference circuit terminal 1.

11. Verify the scan tool Brake Controls Brake Pedal Position Sensor Circuit 2 is less than 10%.

⇒ **If 10% or greater**

11.1. Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, vehicle in service mode.

11.2. Test for less than 1 V between the signal circuit terminal 6 and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

11.3. Vehicle OFF.

11.4. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K17 Electronic Brake Control Module.

⇓ **If less than 10%**

12. Replace the B201 Brake Control Brake Pedal Position Sensor.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Brake Pedal Position Sensor Replacement (Travel Sensor) on page 4-170* or *Brake Pedal Position Sensor Replacement (Apply Sensor) on page 4-171*
- *Brake Pressure Modulator Valve Replacement on page 5-76*
- *Control Module References on page 6-3* for electronic brake control module replacement, programming and setup

DTC C0552 or C121D

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provide an overview of each diagnostic category.

DTC Descriptors

DTC C0552 00: Improper Shutdown Malfunction

DTC C121D: Electronic Brake Control Module Internal Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	C0256 04, C12E5 00	C0256 04, C12E5 00	—	C0552 00, C121D
Ground Terminal 13	—	C056D 00, C12DA 00, C12D7 00	—	—
Ground Terminal 38	—	U0129 00, U1833 00	—	—

Circuit/System Description

The electronic brake control module monitors the number of Vehicle in Service Mode and Vehicle OFF cycles. When it detects that a Vehicle OFF cycle was incomplete or non-existent this fault will set. This means the fault reports a problem that occurred at the end of the previous ignition cycle. If this occurs during an electronic brake control module service operation, any calibrations or offsets learned during that service operation may not be properly stored in memory.

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.
- The electronic brake control module is initializing.

Conditions for Setting the DTC

A Vehicle OFF cycle was interrupted before completion. Or power was removed from the module; with the Vehicle ON, the vehicle moving, and the brake applied.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Diagnostic Aids

This DTC may set if battery voltage drops below 8 V with the Vehicle ON or Vehicle in Service Mode.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the K17 Electronic Brake Control Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal listed below and ground:
   - Terminal 13
   - Terminal 38

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

4.1. Vehicle OFF.

4.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

4.1. Vehicle OFF.

4.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K17 Electronic Brake Control Module.

5. Cycle the Vehicle OFF then to Vehicle in Service Mode.
6. Verify DTC C0552 or C121D is not set.

⇒ **If DTC C0552 or C121D is set**

Replace the K17 Electronic Brake Control Module.

⇓ **If DTC C0552 or C121D is not set**

7. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for Electronic Brake Control Module replacement, programming and setup

DTC C0561

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C0561 4B: System Disabled Information Stored Calibration Not Learned

DTC C0561 54: System Disabled Information Stored High Temperature

Circuit/System Description

The electronic brake control module receives data from other modules; engine control module, body control module, inflatable restraint sensing and diagnostic module, 14 V accessory power module, hybrid powertrain control module 1, and hybrid powertrain control module 2. The multi-axis acceleration sensor and the steering wheel angle sensor are needed to perform brake control functions. The module must ensure that all serial data and sensor inputs are properly received and learned.

Conditions for Running the DTC

- Ignition voltage is greater than 10 V.
- Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

DTC C0561 4B

- The electronic brake control module learn failed.
- Air in the hydraulic brake system or incorrect brake bleed.
- This diagnostics detects if one or more of the module learning steps was not performed during a new component replacement or with a reprogrammed module.

DTC C0561 54

This diagnostics detects an over temperature condition with one of the twelve solenoids due to an extended ABS, traction control and vehicle stability event lasting more than 45 seconds.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- A message may be displayed.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The electronic brake control module disables the ABS, the dynamic rear proportioning, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- It may take two Vehicle ON cycles to clear this DTC.
- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Diagnostic Aids

DTC C0561 4B

- This DTC may set during a battery disconnect.
- The module set up was not performed after a programming event.
- Check for hydraulic leaks, air in the brake system or incorrect brake bleed.
- If the learn failed, vehicle in service mode, command the ABS Pump Motor On to build up brake pressure and perform the electronic brake control module learn.

DTC C0561 54

Excessive traction control event for greater than 45 seconds.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

DTC C0561 4B

Note: The 12 V battery must be able to maintain a charge during this brake sensor performance procedure. It is recommended that a charger/maintainer or equivalent be used to maintain proper battery voltage during this procedure.

1. Vehicle in Service Mode with the transmission in PARK.
2. Command the ABS Pump Motor On with a scan tool.

   Note: Do not depress the brake pedal during the Electronic Brake Control Module Learn procedure.
3. Perform the Electronic Brake Control Module Learn procedure with a scan tool.

   Note: To ensure the complete brake modulator and high pressure accumulator pressure relief procedure is allowed to occur; the brake controller must see 1 pedal apply with the propulsion system enabled, followed by a proper shutdown without applying the brake pedal.
4. Vehicle ON, apply and release the brake pedal.
5. Vehicle OFF, without applying the brake pedal ensure the brake modulator and high pressure accumulator pressure relief occurs. This process will take approximately 1-3 minutes.
6. Remove the remote keyless entry transmitter and close all of the vehicle doors. Wait approximately 1-3 minutes until the brake modulator and the high pressure accumulator pressure relief is complete and the vehicle powers down.
7. Vehicle in Service Mode.
8. Verify the scan tool parameters listed below are within the specified range:
   - Brake Controls Brake Pedal Position Sensor 5 V Supply Voltage – Between 4.75–5.25 V
   - Brake Controls Brake Pedal Position Sensor Circuit 1 – Between 1.4–1.7 V
   - Brake Controls Brake Pedal Position Sensor Circuit 2 – Between 58–78%

⇒ **If any parameter is not within the specified range**

Refer to *DTC C029C, C120C, C129A-C129F, C12B1, or C12F8 on page 5-44*.

⇓ **If all parameters are within the specified range**

9. Vehicle ON, brakes not applied.
10. Verify the scan tool parameters listed below are less the specified range:
    - Brake Master Cylinder Pressure Sensor – Less than 100 kPa (15 psi)
    - Brake Pressure Sensor – Less than 100 kPa (15 psi)
    - High Pressure Accumulator Sensor – Less than 800 kPa (116 psi)

⇒ **If any parameter is greater than the specified range**

Replace the Q5 Brake Pressure Modulator.

⇓ **If all parameters are less than the specified range**

11. Perform a hydraulic brake system test, refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*.

⇒ **If the hydraulic brake system test does not pass**

Repair or replace the applicable component.

⇓ **If the hydraulic brake system tests normal**

12. Replace the Q5 Brake Pressure Modulator.
13. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

⇒ **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

⇓ **If the DTC does not set**

14. All OK.

DTC C0561 54

Note: This diagnostic detects an over temperature condition with 1 of the 12 solenoids due to an extended ABS, traction control and vehicle stability event lasting more than 45 seconds. This does not indicate a failure with the Electronic Brake Control Module.

1. Verify DTC C0561 54 does not set while operating the vehicle under normal driving conditions.

⇒ **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

⇓ **If the DTC does not set**

2. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Brake Pressure Modulator Valve Replacement on page 5-76*
- *Control Module References on page 6-3* for electronic brake control module replacement, programming and setup

DTC C056D, C127A-C127C, C12E9, C12F2-C12F6, or C12FE

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provide an overview of each diagnostic category.

DTC Descriptors

DTC C056D 00: Electronic Control Unit Hardware
DTC C056D 3C: Electronic Control Unit Hardware Internal Communication Malfunction
DTC C121C 00: Electronic Brake Control Module Internal Communication Malfunction
DTC C121D 00: Electronic Brake Control Module Internal Malfunction
DTC C121E 00: Electronic Brake Control Module Malfunction
DTC C121F 00: Electronic Brake Control Module Supervision Software Malfunction
DTC C123A 00: Electronic Brake Control Module RAM Watchdog
DTC C123B 00: Electronic Brake Control Module RAM Program Overflow
DTC C123C 00: Electronic Brake Control Module RAM Malfunction
DTC C123D 00: Electronic Brake Control Module Solenoid Valve Time-out
DTC C123E 00: Electronic Brake Control Module RAM Periodic Interrupt
DTC C123F 00: Electronic Brake Control Module Serial Peripheral Interface Malfunction
DTC C1255 00: Electronic Control Unit Performance
DTC C1256 00: Control Module Programming Checksum Error
DTC C126C 00: Electronic Brake Control Module Communication Bus B Performance
DTC C126D 00: Electronic Brake Control Module Communication Bus B RAM Malfunction
DTC C126E 00: Electronic Brake Control Module Supervision Software Malfunction
DTC C126F 00: Electronic Brake Control Module Serial Peripheral Interface Performance
DTC C127A 00: Electronic Brake Control Module RAM Performance
DTC C127B 00: Electronic Brake Control Module Processor Performance
DTC C127C 00: Electronic Brake Control Module Self Test Malfunction
DTC C127D 00: Electronic Brake Control Module Internal Malfunction
DTC C12D6 00: ABS Normally Open Base Brake Solenoid Valve Circuit Open
DTC C12D7 00: ABS Normally Open Base Brake Solenoid Valve Circuit Shorted
DTC C12D8 00: ABS Normally Open Base Brake Solenoid Valve Driver Shorted
DTC C12D9 00: ABS Normally Closed Base Brake Solenoid Valve Circuit Open
DTC C12DA 00: ABS Normally Closed Base Brake Solenoid Valve Circuit Shorted
DTC C12DB 00: ABS Normally Closed Base Brake Solenoid Valve Driver Shorted
DTC C12E3 00: Electronic Brake Control Module Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ Terminal 1	C0256 04, C12E5 00	C0256 04, C12E5 00	—	—
B+ Terminal 25	C0201 04	C0201 04	—	—
Ground Terminal 13	—	C056D 00, C12DA 00, C12D7 00	—	—
Ground Terminal 38	—	U0129 00, U1833 00	—	—

Circuit/System Description

The electronic brake control module detects an internal malfunction.

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.
- Ignition voltage is between 8 V and 16 V.

Conditions for Setting the DTC

- An open electronic brake control module ground circuit.
- The electronic brake control module detects an internal malfunction.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- A message may be displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the K17 Electronic Brake Control Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal listed below and ground:
   - Terminal 13
   - Terminal 38

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify that a test lamp illuminates between the B+ circuit terminal 1 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

4.1. Vehicle OFF.

4.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance the in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

4.1. Vehicle OFF.

4.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K17 Electronic Brake Control Module.

⇓ **If the test lamp illuminates**

5. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for Electronic Brake Control Module replacement, programming and setup

DTC C056E

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C056E 42: Electronic Control Unit Software Calibration Not Programmed

DTC C056E 47: Electronic Control Unit Software VIN Not Programmed

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.
- Ignition voltage is greater than 8 V.

Conditions for Setting the DTC

A new service replacement electronic brake control module contains a unique manufacturing calibration. This DTC will be current whenever a new electronic brake control module is installed on a vehicle prior to the Service Programming System (SPS) event. The DTC will remain current until the electronic brake control module has undergone a successful program. Once the program event is completed, the DTC goes into history and can be cleared. After the DTC is cleared it can not return.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake warning indicator turns ON.
- The traction/stability control indicator turns ON.
- The electronic brake control module disables the ABS, the traction control and the stability control for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Verify that DTC C056E is not set.

⇒ **If the DTC is set**

1.1. Vehicle ON

1.2. Program the K17 Electronic Brake Control Module.

1.3. Verify the DTC does not set after driving the vehicle above 40 km/h (25 MPH).

⇒ If the DTC sets, replace the K17 Electronic Brake Control Module.

⇓ If the DTC does not set.

1.4. All OK.

⇓ **If the DTC is not set**

2. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for Electronic Brake Control Module replacement, programming and setup

DTC C0574

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C0574 11: Printed Circuit Board Temperature Sensor High Input

Circuit/System Description

The electronic brake control module monitors the internal temperature sensor.

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

The temperature sensor value is greater than 284° F for greater than 1 second.

Action Taken When the DTC Sets

No indicators or warning messages are displayed.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Diagnostic Aids

Diagnose all other electronic brake control module system related faults first, if DTC C0574 goes into history after a 15 minute cool down period. Other electronic brake control module faults may cause the circuit board to overheat.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set.

⇒ **If any other DTCs are set**

Refer to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92*.

⇓ **If no other DTCs are set**

3. Verify that DTC C0574 does not set while driving the vehicle within normal braking conditions.

⇒ **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

⇓ **If the DTC does not set**

4. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for Electronic Brake Control Module replacement, programming and setup

DTC C0710

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C0710 00: Steering Wheel Angle Signal
DTC C0710 09: Steering Wheel Angle Signal Too Fast Transitions
DTC C0710 0A: Steering Wheel Angle Signal Too Slow Transitions
DTC C0710 11: Steering Wheel Angle Signal High Input
DTC C0710 18: Steering Wheel Angle Signal Low Signal Amplitude
DTC C0710 19: Steering Wheel Angle Signal High Signal Amplitude
DTC C0710 4B: Steering Wheel Angle Signal Calibration Not Learned

Circuit/System Description

The steering wheel angle sensor is integrated in the steering column assembly. The steering wheel angle sensor identifies the position and direction of the steering wheel rotation.

The electronic brake control module receives high speed serial data inputs from the steering angle sensor identifying the position and direction of the steering wheel rotation. The electronic brake control module utilizes this signal to calculate the driver intended driving direction.

Conditions for Running the DTC

C0710 00, or C0710 11

Drive the vehicle straight ahead with a constant speed no greater than 15 km/h (9.32 MPH) for a distance at least 1.6 km (1 mi).

C0710 09, or C0710 4B

Vehicle ON or Vehicle in Service Mode.

C0710 0A

Vehicle stopped turn the steering wheel through its entire range of motion from right to left.

C0710 18, or C0710 19

Drive the vehicle straight ahead with constant velocity greater than 15 km/h (9.32 MPH), then turn right and then turn left.

Conditions for Setting the DTC

C0710 00

The steering wheel angle sensor signal offset is out of the specified range.

C0710 09

The steering wheel angle sensor signal rate of change is to fast greater than 30°.

C0710 0A

The steering wheel angle sensor signal has not changed.

C0710 11

The steering wheel angle sensor signal is above the maximum specification.

C0710 18

The steering wheel angle sensor signal is not correlating with the yaw rate sensor signal.

C0710 19

The steering wheel angle sensor signal has a greater value than physically possible.

C0710 4B

The steering wheel angle sensor is not calibrated.

Action Taken When the DTC Sets

- The traction/stability control indicator turns ON.
- A Service StabiliTrak message may displayed on the driver information center.
- A Service Brake Assist message may displayed on the driver information center.
- A Service Power Steering Drive with Care message may displayed on the driver information center.
- The electronic brake control module disables the traction control and the electronic stability control for the duration of the ignition cycle.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Diagnostic Aids

- Check and adjust all tires to the stated cold air pressure as identified on the tire placard.
- The car should not pull in either direction causing the steering wheel to be off center while driving in a straight line on a level surface.
- Confirm that all tires are of the proper size and matching brands. If a mis-sized or non-matching brand tire is present, inform the customer that in order for the vehicle stability enhanced system to function normally, tires need to be a uniform size and rolling diameter.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify the scan tool Steering Wheel Angle parameter value constantly changes from +330° to −330° as the steering wheel is turned through its entire range from left to right.

⇒ **If the parameter does not change**

Calibrate the K43 Power Steering Control Module.

⇓ **If the parameter changes**

3. Verify that DTC C0710 4B is not set.

⇒ **If DTC C0710 4B is set**

Perform the *Steering Angle Sensor Centering on page 5-74*.

⇓ **If DTC C0710 4B is not set**

4. Verify that DTC C0460 is not set.

⇒ **If DTC C0460 is set**

Refer to *DTC C0460 on page 14-7*.

⇓ **If DTC C0460 is not set**

5. Replace the steering column assembly.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Steering Column Replacement on page 14-34*
- *Control Module References on page 6-3* for power steering control module replacement, programming and setup.

DTC C0870 or C12E4

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C0870 00: Control Module Voltage Reference Output 1 Circuit Malfunction

DTC C12E4 00: ABS Sensor Reference Output Circuit

Circuit/System Description

The Electronic Brake Control Module supplies a shared 5 V reference to multiple sensors.

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

The electronic brake control module detects an internal 5 V supply failure.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction control/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information center.
- The electronic brake control module disables the ABS, traction control and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC C0870 or C12E4 is not set.

⇒ **If either DTC is set**

Replace the K17 Electronic Brake Control Module.

⇓ **If either DTC is not set**

3. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for Electronic Brake Control Module replacement, programming and setup

DTC C0880, C12E5, or C120F

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C0880 00: Control Module Voltage Reference Output 2 Circuit Malfunction
DTC C12E5 00: Brake Pedal Position Sensor Reference Circuit
DTC C0880 02: Control Module Voltage Reference Output 2 Circuit Short to Ground
DTC C120F 00: Brake Pedal Position Sensor Supply Circuit Low Input

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	C0110 00, C0880 00, C0880 02, C029C 5A, C120F 00, C12E0 00, C12E5 00	C0110 00, C029C 03, C029C 07, C029C 5A, C129A 00, C129E 00, C12E0 00	C0110 00, C0880 00, C029C 5A, C12E0 00, C12E5 00	C12B1 00, C12F8 00
Brake Pedal Travel Sensor 1 Signal	C029C 03, C129A 00	C0110 00, C0294 00, C029C 03, C029C 5A, C129A 00, C12E0 00, C12F8 00	C0110 00, C0880 00, C029C 5A, C12E0 00, C12E5 00	C12B1 00, C12F8 00
Brake Pedal Travel Sensor 2 Signal	C029C 03, C129D 00	C0110 00, C029C 07, C129E 00, C12E0 00	C0110 00, C029C 07, C129E 00, C12E0 00	C12B1 00, C12F8 00
Low Reference	—	C0110 00, C0294 00, C029C 07, C029C 5A, C129E 00, C12E0 00, C12F8 00	—	—

Circuit/System Description

The body control module supplies a 5 V reference to the brake pedal position sensor.

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

- A short to ground or a short to voltage on the 5 V reference circuit to the brake pedal position sensor.
- A short to voltage on the sensor 1 signal circuit to the brake pedal position sensor.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- A message may be displayed.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Testing

1. Vehicle in Service Mode.
2. Verify that DTC C029C is not set.

⇒ **If the DTC is set**

Refer to *DTC C029C, C120C, C129A-C129F, C12B1, or C12F8 on page 5-44*.

⇓ **If the DTC is not set**

3. Vehicle OFF, disconnect the harness connector at the B22 Brake Pedal Position Sensor, vehicle in Service Mode.
4. Verify a test lamp illuminates between the low reference circuit terminal A and B+.

⇒ **If the test lamp does not illuminate**

4.1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.

4.2. Test for less than 2 Ω in the low reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If the test lamp illuminates**

5. Vehicle in Service Mode.
6. Test for 4.8–5.2 V between the 5 V reference circuit terminal C and ground.

⇒ **If less than 4.8 V**

6.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.

6.2. Test for infinite resistance between the 5 V reference circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

6.3. Test for less than 2 Ω in the 5 V reference circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇒ **If greater than 5.2 V**

6.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.

6.2. Test for less than 1 V between the 5 V reference circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If between 4.8–5.2 V**

7. Verify the scan tool Brake Pedal Applied parameter is Inactive.

⇒ **If not Inactive**

7.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.

7.2. Test for less than 1 V between the signal circuit terminal B and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇒ If less than 1 V, replace the K9 Body Control Module.

⇓ **If Active**

8. Install a 3 A fused jumper wire between the 5 V reference circuit terminal C and the signal circuit terminal B.
9. Verify the scan tool Brake Pedal Applied parameter is Active.

⇒ **If not Active**

9.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.

9.2. Test for infinite resistance between the signal circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

9.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

10. Test or replace the B22 Brake Pedal Position Sensor.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Brake Pedal Position Sensor Replacement (Travel Sensor) on page 4-170* or *Brake Pedal Position Sensor Replacement (Apply Sensor) on page 4-171*
- *Control Module References on page 6-3* for Body Control Module replacement, programming and setup

DTC C0898

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C0898 00: Control Module Power and Ground Circuits Malfunction
DTC C0898 03: Control Module Power and Ground Circuits Low Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ Terminal 1	C0898 03, C0256 04, C12E5 00	C0898 00, C0256 04, C12E5 00	—	C0552 00, C121D
B+ Terminal 25	C0110 00	C0110 00		
Ground Terminal 13	—	C056D 00, C12DA 00, C12D7 00	—	—
Ground Terminal 38	—	U0129 00, U1833 00	—	—

Circuit/System Description

The electronic brake control module monitors two different blocks of memory to determine its capability to control the system shutdown process.

Conditions for Running the DTC

Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

- Keep alive voltage regulator not functional.
- Processor loses complete battery power.
- Battery voltage is under 9 V and the vehicle is not moving.

Action Taken When the DTC Sets

- A warning indicator may be displayed.
- A driver information center message may be displayed.
- The electronic brake control module disables ABS, traction control system and vehicle stability enhancement system for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The electronic brake control module clears the history DTC when a current DTC is not detected in 40 consecutive drive cycles.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

Check to ensure battery shunt is not opened.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the K17 Electronic Brake Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminals listed below and ground:
   - Terminal 13
   - Terminal 38

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify that a test lamp illuminates between the B+ circuit terminals listed below and ground.
   - Terminal 1
   - Terminal 25

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

4.1. Vehicle OFF.

4.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance or the short to ground in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇓ **If the test lamp illuminates**

5. Vehicle in Service Mode.
6. Verify that a test lamp illuminates between the ignition circuit terminal 14 and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

6.1. Vehicle OFF.

6.2. Test for less than 2 Ω in the ignition circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance or the short to ground in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇓ **If the test lamp illuminates**

7. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for Electronic Brake Control Module replacement, programming and setup

DTC C1120 or C1121

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C1120 00: ABS Left Front Hydraulic Circuit Blocked

DTC C1121 00: ABS Left Front Hydraulic Circuit Leak Detected

Circuit/System Description

The electronic brake control module activates the valve relay to supply voltage to the valve solenoids. This voltage is referred to as the system voltage. The electronic brake control module activates individual valve solenoids by grounding the valve solenoid control circuits. This verification is used to perform hydraulic checks at the normally open base brake valve, the front hydraulic circuit and the block.

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.
- Accumulator pressure is less than 9,000 kPa (1,305 psi).
- The ignition voltage is greater than 10 V.
- The electronic brake control module performs a hydraulic system check every third drive cycle.
- Brake pedal was depressed.

Conditions for Setting the DTC

C1120 00

This diagnostic detects if the left front circuit is blocked by actively applying pressure and monitoring the accumulator pressure change. The pressure change of the accumulator indicates the value of fluid used which is then compared to expected fluid used during a brake apply. Too little fluid usage indicates a blocked circuit.

C1121 00

This diagnostic detects if the left front circuit is leaking by actively applying pressure and monitoring the accumulator pressure change. The pressure change of the accumulator indicates the volume of fluid used which is then compared to expected fluid used during a brake apply. Too much fluid usage indicated a leaking circuit.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- A message may be displayed.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

Note: The 12 V battery must be able to maintain a charge during this brake sensor performance procedure. It is recommended that a charger/maintainer or equivalent be used to maintain proper battery voltage during this procedure.

1. Vehicle in Service Mode with the transmission in PARK.

   Note: Do not depress the brake pedal during the Electronic Brake Control Module Learn procedure.

2. Perform the Electronic Brake Control Module Learn procedure with a scan tool.

   Note: To ensure the complete brake modulator and high pressure accumulator pressure relief procedure is allowed to occur; the brake controller must see 1 pedal apply with the propulsion system enabled, followed by a proper shutdown without applying the brake pedal.

3. Vehicle ON, apply and release the brake pedal.
   Note: Vehicle OFF, without applying the brake pedal ensure the brake modulator and high pressure accumulator pressure relief occurs. This process will take approximately 1-3 minutes.
4. Vehicle OFF, without applying the brake pedal.
5. Remove the remote keyless entry transmitter and close all of the vehicle doors. Wait approximately 1-3 minutes until the brake modulator and the high pressure accumulator pressure relief is complete and the vehicle powers down.
6. Vehicle in Service Module, brakes not applied.
7. Verify the scan tool parameters listed below are within the specified range:
   - Brake Controls Brake Pedal Position Sensor 5 V Supply Voltage – Between 4.75–5.25 V
   - Brake Controls Brake Pedal Position Sensor Circuit 1 – Between 1.4–1.7 V
   - Brake Controls Brake Pedal Position Sensor Circuit 2 – Between 58–78%

⇒ **If any parameter is not within the specified range**

Refer to *DTC C029C, C120C, C129A-C129F, C12B1, or C12F8 on page 5-44*

⇓ **If all parameters are within the specified range**

8. Verify the scan tool parameters listed below are less the specified range:
   - Brake Master Cylinder Pressure Sensor – Less than 100 kPa (15 psi)
   - Brake Pressure Sensor – Less than 100 kPa (15 psi)
   - High Pressure Accumulator Sensor – Less than 800 kPa (116 psi)

⇒ **If any parameter is greater than the specified range**

Replace the Q5 Brake Pressure Modulator.

⇓ **If all parameters are less than the specified range**

9. Perform a hydraulic brake system test, refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*

⇒ **If the hydraulic brake system test does not pass**

Repair as necessary.

⇓ **If the hydraulic brake system tests normal**

10. Replace the Q5 Brake Pressure Modulator.
11. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

⇒ **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

⇓ **If the DTC does not set**

12. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Brake Pressure Modulator Valve Replacement on page 5-76*
- *Control Module References on page 6-3* for Electronic Brake Control Module replacement, programming and setup

DTC C1122 or C1123

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C1122 00: ABS Right Front Hydraulic Circuit Blocked

DTC C1123 00: ABS Right Front Hydraulic Circuit Leak Detected

Circuit/System Description

The electronic brake control module activates the valve relay to supply voltage to the valve solenoids. This voltage is referred to as the system voltage. The electronic brake control module activates individual valve solenoids by grounding the valve solenoid control circuits. This verification is used to perform hydraulic checks at the normally open base brake valve, the front hydraulic circuit and the block.

Conditions for Running the DTC

- Brake pedal was depressed.
- Vehicle ON or Vehicle in Service Mode
- The ignition voltage is greater than 10 V.
- Accumulator pressure is less than 9,000 kPa (1,305 psi).
- The electronic brake control module performs a hydraulic system check every third drive cycle.

Conditions for Setting the DTC

C1122 00

This diagnostic detects if the right front circuit is blocked by actively applying pressure and monitoring the accumulator pressure change. The pressure change of the accumulator indicates the value of fluid used which is then compared to expected fluid used during a brake apply. Too little fluid usage indicates a blocked circuit.

C1123 00

This diagnostic detects if the right front circuit is leaking by actively applying pressure and monitoring the accumulator pressure change. The pressure change of the accumulator indicates the volume of fluid used which is then compared to expected fluid used during a brake apply. Too much fluid usage indicated a leaking circuit.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- A message may be displayed.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The electronic brake control module disables the ABS, the traction control and the electronic stability for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

Note: The 12 V battery must be able to maintain a charge during this brake sensor performance procedure. It is recommended that a charger/maintainer or equivalent be used to maintain proper battery voltage during this procedure.

1. Vehicle in Service Mode with the transmission in PARK.

   Note: Do not depress the brake pedal during the Electronic Brake Control Module Learn procedure.

2. Perform the Electronic Brake Control Module Learn procedure with a scan tool.

   Note: To ensure the complete brake modulator and high pressure accumulator pressure relief procedure is allowed to occur; the brake controller must see 1 pedal apply with the propulsion system enabled, followed by a proper shutdown without applying the brake pedal.

3. Vehicle ON, apply and release the brake pedal.

   Note: Vehicle OFF, without applying the brake pedal ensure the brake modulator and high pressure accumulator pressure relief occurs. This process will take approximately 1-3 minutes.

4. Vehicle OFF, without applying the brake pedal.
5. Remove the remote keyless entry transmitter and close all of the vehicle doors. Wait approximately 1-3 minutes until the brake modulator and the high pressure accumulator pressure relief is complete and the vehicle powers down.
6. Vehicle in Service Mode, brakes not applied.
7. Verify the scan tool parameters listed below are within the specified range:
   - Brake Controls Brake Pedal Position Sensor 5 V Supply Voltage – Between 4.75–5.25 V
   - Brake Controls Brake Pedal Position Sensor Circuit 1 – Between 1.4–1.7 V
   - Brake Controls Brake Pedal Position Sensor Circuit 2 – Between 58–78%

⇒ **If any parameter is not within the specified range**

Refer to *DTC C029C, C120C, C129A-C129F, C12B1, or C12F8 on page 5-44*

⇓ **If all parameters are within the specified range**

8. Verify the scan tool parameters listed below are less the specified range:
   - Brake Master Cylinder Pressure Sensor – Less than 100 kPa (15 psi)
   - Brake Pressure Sensor – Less than 100 kPa (15 psi)
   - High Pressure Accumulator Sensor – Less than 800 kPa (116 psi)

⇒ **If any parameter is greater than the specified range**

Replace the Q5 Brake Pressure Modulator.

⇓ **If all parameters are less than the specified range**

9. Perform a hydraulic brake system test, refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*

⇒ **If the hydraulic brake system test does not pass**

Repair as necessary.

⇓ **If the hydraulic brake system tests normal**

10. Replace the Q5 Brake Pressure Modulator.
11. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

⇒ **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

⇓ **If the DTC does not set**

12. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Brake Pressure Modulator Valve Replacement on page 5-76*
- *Control Module References on page 6-3* for Electronic Brake Control Module replacement, programming and setup

DTC C1124 or C1125

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptors

DTC C1124 00: ABS Normally Open Base Brake Solenoid Valve Circuit Open

DTC C1125 00: Excessive Hydraulic Circuit Test Duration

Circuit/System Description

The electronic brake control module activates the valve relay to supply voltage to the valve solenoids. This voltage is referred to as the system voltage. The electronic brake control module activates individual valve solenoids by grounding the valve solenoid control circuits. This verification is used to perform hydraulic checks at the normally open base brake valve.

Conditions for Running the DTC

- Brake pedal was depressed.
- Vehicle ON or Vehicle in Service Mode
- The ignition voltage is greater than 10 V.
- Accumulator pressure is less than 9,000 kPa (1,305 psi).
- The electronic brake control module performs a hydraulic system check every third drive cycle.

Conditions for Setting the DTC

C1124 00

This diagnostic determines if the normally open valve has been blocked, closed, or stuck shut. This diagnostic runs while the accumulator is being discharged during the hydraulic shutdown.

C1125 00

This code is an information code only, and requires no diagnostics.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- A message may be displayed.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The electronic brake control module disables the ABS, the traction control and the electronic stability for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

Note: The 12 V battery must be able to maintain a charge during this brake sensor performance procedure. It is recommended that a charger/maintainer or equivalent be used to maintain proper battery voltage during this procedure.

1. Vehicle in Service Mode with the transmission in PARK.

   Note: Do not depress the brake pedal during the Electronic Brake Control Module Learn procedure.

2. Perform the Electronic Brake Control Module Learn procedure with a scan tool.

   Note: To ensure the complete brake modulator and high pressure accumulator pressure relief procedure is allowed to occur; the brake controller must see 1 pedal apply with the propulsion system enabled, followed by a proper shutdown without applying the brake pedal.

3. Vehicle ON, apply and release the brake pedal.

   Note: Vehicle OFF, without applying the brake pedal ensure the brake modulator and high pressure accumulator pressure relief occurs. This process will take approximately 1-3 minutes.

4. Vehicle OFF, without applying the brake pedal.
5. Remove the remote keyless entry transmitter and close all of the vehicle doors. Wait approximately 1-3 minutes until the brake modulator and the high pressure accumulator pressure relief is complete and the vehicle powers down.
6. Vehicle in Service Mode, brakes not applied.
7. Verify the scan tool parameters listed below are within the specified range:
   - Brake Controls Brake Pedal Position Sensor 5 V Supply Voltage – Between 4.75–5.25 V
   - Brake Controls Brake Pedal Position Sensor Circuit 1 – Between 1.4–1.7 V
   - Brake Controls Brake Pedal Position Sensor Circuit 2 – Between 58–78%

⇒ **If any parameter is not within the specified range**

Refer to *DTC C029C, C120C, C129A-C129F, C12B1, or C12F8 on page 5-44*

⇓ **If all parameters are within the specified range**

8. Verify the scan tool parameters listed below are less the specified range:
   - Brake Master Cylinder Pressure Sensor – Less than 100 kPa (15 psi)
   - Brake Pressure Sensor – Less than 100 kPa (15 psi)
   - High Pressure Accumulator Sensor – Less than 800 kPa (116 psi)

⇒ **If any parameter is greater than the specified range**

Replace the Q5 Brake Pressure Modulator.

⇓ **If all parameters are less than the specified range**

9. Perform a hydraulic brake system test, refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*

⇒ **If the hydraulic brake system test does not pass**

Repair as necessary.

⇓ **If the hydraulic brake system tests normal**

10. Replace the Q5 Brake Pressure Modulator.
11. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

⇒ **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

⇓ **If the DTC does not set**

12. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Brake Pressure Modulator Valve Replacement on page 5-76*
- *Control Module References on page 6-3* for Electronic Brake Control Module replacement, programming and setup

DTC P1B12

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for a overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptor

DTC P1B12: Driver Intended Braking Torque Signal Message Counter Incorrect

Circuit/System Description

The electronic brake control module provides brake pedal position information to the engine control module, via the serial data circuit. The engine control module monitors a series of 16 rolling counts, with each count assigned a value, when the engine control module determines that too many of the counts have an incorrect value, the engine control module sets DTC P1B12.

Conditions for Running the DTC

- The propulsion system is active.
- DTC P1B12 runs continuously when the above condition is met.

Conditions for Setting the DTC

The engine control module detects that 10 of the 16 rolling counts have an incorrect value.

Action Taken When the DTC Sets

DTC P1B12 is a Type C DTC.

Conditions for Clearing the DTC

DTC P1B12 is a Type C DTC.

Diagnostic Aids

- DTC P1B12 is an informational DTC.
- Verify the electronic brake control module and engine control module contain the latest calibrations.
- Diagnose all other engine control module DTCs prior to DTC P1B12.
- Find out from the customer the conditions under which the DTC was set. This information may help duplicate the concern like the specific number of brake pedal applies in a row prior to the fault set.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions on page 6-92

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Verify that no other DTCs are set except for DTC P1B12 is set.

⇒ **If any other DTCs are set**

Refer to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92*.

⇓ **If no other DTCs are set**

2. Replace the K17 Electronic Brake Control Module.
3. Verify the DTC P1B12 does not set while operating the vehicle within the Conditions for Running the DTC.

⇒ **If only DTC P1B12 is set**

Replace the K20 Engine Control Module.

⇓ **If the DTC does not set**

4. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the diagnostic procedure.

Control Module References on page 6-3 for Electronic Brake Control Module and Engine Control Module replacement, programming and setup.

Symptoms - Antilock Brake System

Note: The following steps must be completed before using the symptom tables.

1. Perform the *Diagnostic System Check - Vehicle on page 6-91* before using the symptom tables in order to verify that all of the following are true:
   - There are no DTCs set.
   - The control modules can communicate via the serial data link.
2. Review the system description and operation in order to familiarize yourself with the system functions. Refer to *ABS Description and Operation on page 5-91*.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the ABS. Refer to *Checking Aftermarket Accessories on page 11-871*.
- Inspect the easily accessible or visible system components, for obvious damage or conditions, which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to *Testing for Intermittent Conditions and Poor Connections on page 11-877*.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- *Brake Warning Indicator Malfunction on page 5-137*
- *Hill Start Assist Malfunction on page 5-70*
- *Traction Control/Stability Control Indicator Malfunction on page 5-71*

Hill Start Assist Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Circuit/System Description

The hill start assist allows the driver to launch the vehicle without roll back when moving their foot from the brake pedal to the accelerator pedal while on a slope or incline. The hill start assist function activates automatically based on the percent of the hill grade which is estimated by the longitudinal accelerometer. The electronic brake control module calculates the brake pressure, which is needed to hold the vehicle on an incline and locks that pressure by commanding the appropriate solenoid valves ON and OFF. The release of the hill start assist is based on the position of the accelerator pedal and the required engine torque is enough to prevent the vehicle from rolling down the hill.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that no other DTCs are set.

⇒ **If any other DTCs are set**

Refer to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92*.

⇓ **If no other DTCs are set**

3. Perform the *Vehicle Yaw Sensor Learn on page 5-90*.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Traction Control/Stability Control Indicator Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B2745 02	1	1	B2745 71
Ground	—	1	—	—
1. Traction control switch inoperative				

Circuit/System Description

The body control module monitors the signal circuit from the traction control switch. When the traction control switch is pressed once, the body control module will request the electronic brake control module via serial data to disable the traction control. The electronic brake control module will request the instrument cluster via serial data to turn the digital traction control Off indicator ON to notify the driver of the deactivation.

When the traction control switch is pressed and held for five seconds, the body control module will request the electronic brake control module to disable the electronic stability control. The electronic brake control module will request the instrument cluster via serial data to turn the digital traction control Off and the stability control Off indicators ON to notify the driver of the deactivation.

Reference Information

Schematic Reference

Antilock Brake System Schematics on page 5-6

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

ABS Description and Operation on page 5-91

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the instrument cluster traction/stability control indicator turns On and Off when commanding the Instrument Cluster All Indicators On and Off with a scan tool.

⇒ **If the indicator does not turn On and Off**

Replace the P16 Instrument Cluster.

⇓ **If the indicator turns On and Off**

3. Verify the scan tool Body Control Module Traction Control Switch parameter changes between Active and Inactive while pressing and releasing the traction control switch.

⇒ **If the parameter does not change**

Refer to Circuit/System Testing.

⇓ **If the parameter changes**

4. All OK.

Circuit/System Testing

1. Vehicle OFF, scan tool disconnected, and all vehicle systems OFF, disconnect the harness connector at the S48E Multifunction Switch-Center Console. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 9 and ground.

⇒ **If 5 Ω or greater**

2.1. Vehicle OFF

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 5 Ω**

3. Vehicle in Service Mode.

4. Verify the scan tool Traction Control Switch parameter is Inactive.

⇒ **If not Inactive**

4.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.

4.2. Test for infinite resistance between the signal circuit terminal 14 and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K9 Body Control Module.

⇓ **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 5 and the ground circuit terminal 9.
6. Verify the scan tool Traction Control Switch parameter is Active.

⇒ **If not Active**

6.1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in service mode.

6.2. Test for less than 1 V between the signal circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V

6.3. Vehicle OFF.

6.4. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If Active**

7. Test or replace the S48E Multifunction Switch-Center Console.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the S48E Multifunction Switch-Center Console.
2. Test for infinite resistance between the signal terminal 5 and the ground terminal 9 with the switch in the open position.

⇒ **If less than infinite resistance**

Replace the S48E Multifunction Switch-Center Console.

⇓ **If infinite resistance**

3. Test for less than 2 Ω between the signal circuit terminal 5 and the ground terminal 9 with the switch in the closed position.

⇒ **If 2 Ω or greater**

Replace the S48E Multifunction Switch-Center Console.

⇓ **If less than 2 Ω**

4. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Instrument Cluster Replacement on page 8-95*
- *Vehicle Stability Control System Switch Replacement on page 5-90*
- *Control Module References on page 6-3* for body control module or instrument cluster replacement, programming and setup

Repair Instructions

Antilock Brake System Automated Bleed

Special Tools

- *CH-29532-A* Brake Pressure Bleeder
- *CH-44894-A* Brake Bleeder Adapter
- *EL-47955* Multi Diagnostic Interface (MDI)

For equivalent regional tools, refer to *Special Tools on page 5-95*.

Warning: At times during this brake bleed procedure brake fluid will be under higher pressures than during typical brake bleed procedures. Ensure the bleeder hose attached to the bleeder valve is securely maintained in position whenever the bleeder valve is opened. Failure to maintain the bleeder hose securely to the valve when opened, may allow the hose to blow off and brake fluid to spray out of the bleeder valve, possibly resulting in personal injury.

Caution: Only use products that comply with GM specifications and check manufacturer information respectively. We recommend the use of GM genuine products. Instructions must be followed at all times. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

Note:

- Do not pressurize the brake pressure bleeder *CH-29532-A* Brake Pressure Bleeder and thereby the master cylinder reservoir until instructed to do so by the scan tool. Portions of the automated bleed process require the master cylinder reservoir not be pressurized through the *CH-29532-A* Brake Pressure Bleeder.
- Do not apply the brake pedal until instructed to do so by the scan tool. Applying the brake pedal before instructed by the scan tool may result in setting a DTC and may require the sensor and boost valve calibration and electronic brake control module (EBCM) learn procedures to be repeated manually.

Note: The base brake bleed procedure must be completed prior to performing the antilock brake system automated bleed.

1. Perform the hydraulic brake system pressure bleed on all 4 brake corners. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*

   Note: The transmission must be in the PARK position, the power button in the OFF position, and the brakes not applied to ensure the brake modulator and high pressure accumulator (HPA) pressure relief occurs. This process will take approximately 1 to 3 minutes.
2. Place the transmission in PARK.
3. Place the power button in the OFF position.
4. Wait approximately 3 minutes for the HPA pressure relief to occur.

   Note: Approximately **2.5–3.0 L (2.6–3.2 qt)** of brake fluid will be used throughout this procedure. Ensure there is an adequate supply of brake fluid in the *CH-29532-A* Brake Pressure Bleeder.
5. Inspect the fluid level in the *CH-29532-A* Brake Pressure Bleeder. Clean the outside of the *CH-29532-A* Brake Pressure Bleeder and add GM approved brake fluid from a clean, sealed brake fluid container, as necessary. Refer to *Adhesives, Fluids, Lubricants, and Sealers on page 5-133*.
6. Clean the outside of the master cylinder reservoir on and around the reservoir cap prior to removing the cap and diaphragm.
7. Install the *CH-44894-A* Brake Bleeder Adapter and the *CH-29532-A* Brake Pressure Bleeder to the vehicle.

   Note: Ensure a MINIMUM of **200 kPa (30 psi)** of pressure is MAINTAINED in the *CH-29532-A* Brake Pressure Bleeder throughout this procedure, except as instructed.
8. Set the pressure regulator of the *CH-29532-A* Brake Pressure Bleeder to **207 to 414 kPa (30 to 60 psi)**.
9. Open the *CH-29532-A* Brake Pressure Bleeder fluid tank valve to allow pressurized brake fluid to enter the brake system.
10. Wait approximately 30 seconds, then inspect the entire hydraulic brake system to ensure there are no existing external brake fluid leaks.

Danger: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

11. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
12. Remove the tire and wheel assemblies. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
13. Inspect the brake system for leaks and visual damage. Refer to *Symptoms - Hydraulic Brakes on page 5-136*. Repair or replace components as necessary.
14. Secure bleeder hoses to the rear brake caliper bleeder valves.
15. Lower the vehicle to allow for entry and exit while bleeding the brake corners and other components.
16. Release the pressure from the *CH-29532-A* Brake Pressure Bleeder.
17. Connect a battery charger with **20 amp** output to the **12V** battery. The battery charger must remain connected and maintain **12V 20 amp** for the entire automated bleed procedure. Refer to *Battery Charging on page 9-16*.
18. Install a scan tool to the vehicle.

    Note: The power button must remain in the Service Mode during this entire procedure.
19. Place the power button in the Service Mode position.

    Note: Do not pressurize the pressure bleeder *CH-29532-A* Brake Pressure Bleeder, and thereby the master cylinder reservoir, until instructed to do so by the scan tool.
20. Using the scan tool, perform the following steps:
    20.1. Select Diagnostics
    20.2. Enter the VIN
    20.3. Select Module Diagnostics
    20.4. Select Electronic Brake Control Module (EBCM)
    20.5. Select Control Functions
    20.6. Select Automated Brake Bleed
21. Press Continue.
22. Follow all instructions on the scan tool.
23. Remove the *CH-44894-A* Brake Bleeder Adapter and the *CH-29532-A* Brake Pressure Bleeder from the vehicle.

    Note: The system is active and pressurized, therefore the brake fluid level in the master cylinder reservoir cannot be allowed to be higher than the MAX mark of the operating range.
24. Ensure the master cylinder reservoir is filled no higher than the MAX operating range line. Add or remove brake fluid as necessary. Refer to *Master Cylinder Reservoir Filling on page 5-165*.
25. Clear any DTCs from the EBCM.
26. Remove the scan tool from the vehicle.
27. Before activating the power button, firmly apply the brake pedal several times.
28. Observe the brake pedal feel.
29. If the brake pedal feels spongy, perform the following:
    29.1. Repeat the base hydraulic brake system bleeding procedure. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*.
    29.2. If the brake pedal feel is now firm, repeat the automated bleeding procedure.
    29.3. If the brake pedal stills feels spongy after repeating the base hydraulic brake system bleeding procedure, inspect the brake system for external leaks. Refer to *Brake System External Leak Inspection on page 5-162*.

30. If the brake pedal stills feels spongy, and if no external brake fluid leaks are found, inspect the brake system for internal leaks and inspect the brake pedal travel. Refer to *Brake System Internal Leak Test on page 5-163* and *Brake Pedal Travel Measurement and Inspection on page 5-162*.
31. If internal leaks are found, replace the master cylinder. Refer to *Master Cylinder Replacement on page 5-168*.
32. If the brake pedal travel exceeds specification and there is no damage to the pedal system or pushrod, replace the master cylinder. Refer to *Master Cylinder Replacement on page 5-168*.
33. Place the power button in the ON position.
34. Observe if the brake system warning lamp remains illuminated.
35. If the brake system warning lamp remains illuminated, DO NOT allow the vehicle to be driven until the brake system is diagnosed and repaired. Refer to *Symptoms - Hydraulic Brakes on page 5-136*.
36. Firmly apply the brake pedal several times.
37. Observe the brake pedal feel.
38. If the brake pedal feels spongy, repeat the automated bleeding procedure until a firm brake pedal is obtained.
39. Drive the vehicle to a speed above **13 km/h (8 mph)** to allow ABS initialization to occur.
40. Observe the brake pedal feel.
41. If the brake pedal feels spongy, repeat the automated bleeding procedure until a firm brake pedal is obtained.

Steering Angle Sensor Centering

The steering angle sensor does not require centering often. Centering of the steering angle sensor might be required after certain service procedures are performed. Some of these procedures are as follows:

- Wheel alignment
- Steering gear replacement
- Steering column replacement
- Collision or other physical damage
- Power steering control module replacement
- Electronic brake control module replacement

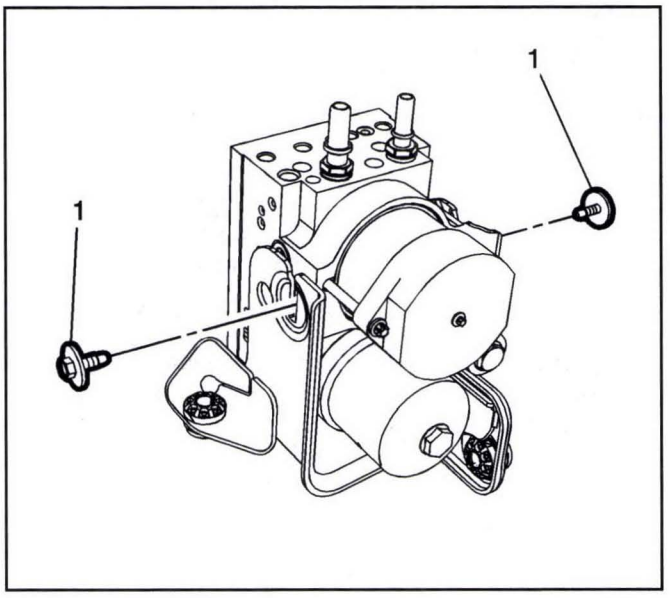
The steering angle sensor centering procedure can be completed with a scan tool using the following steps:

1. Using the steering wheel, align and center the front wheels forward.
2. Apply the parking brake, or set the transmission in Park.
3. Install the scan tool to the data link connector.
4. Vehicle in Service Mode.
5. With the scan tool select the Power Steering Control Module.
6. Select the Steering Wheel Angle Sensor Centering under Configuration/Reset Functions list.
7. Follow the scan tool directions to complete the learn procedure.
8. Clear any DTCs that may be set.
9. Vehicle OFF.

Electronic Brake and Traction Control Module Bracket Replacement

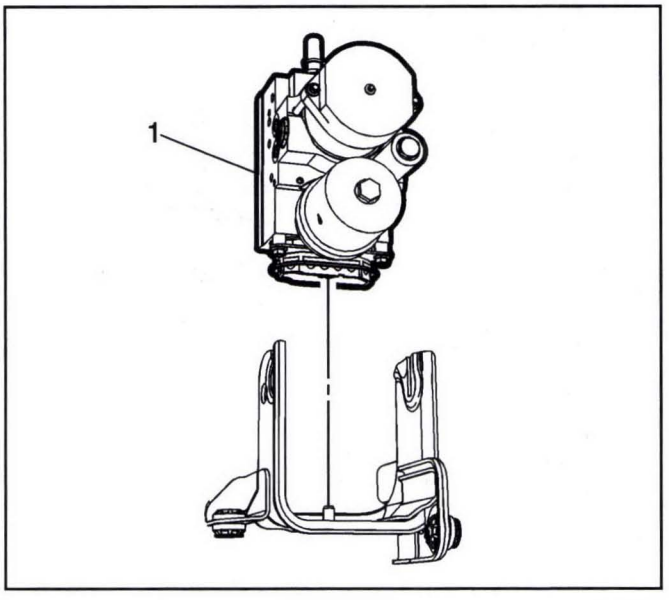
Removal Procedure

1. Remove the brake pressure modulator valve (BPMV) assembly. Refer to *Brake Pressure Modulator Valve Replacement on page 5-76*.



3227182

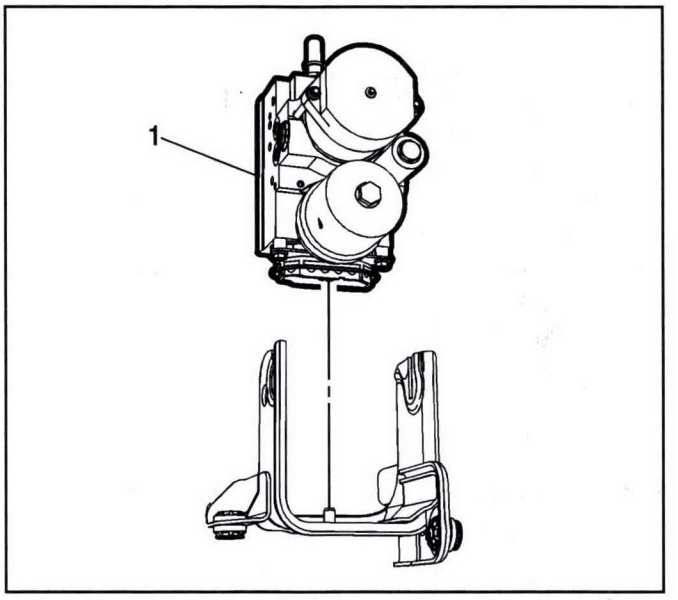
2. Remove the BPMV bolts (1).



3227185

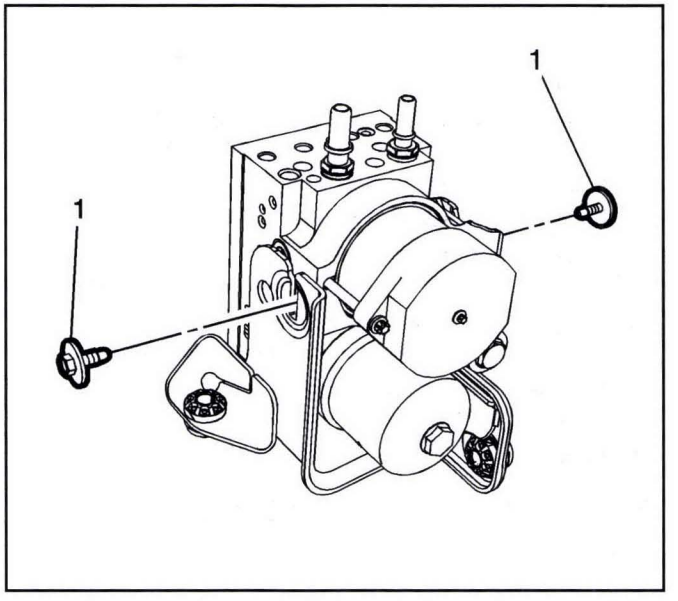
3. Remove the BPMV assembly (1) from the bracket.

Installation Procedure



3227185

1. Install the BPMV assembly (1) to the bracket.



3227182

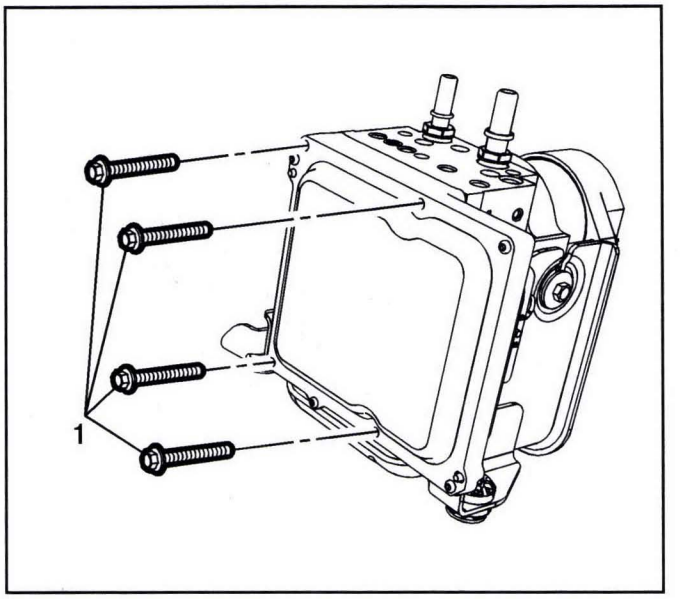
Caution: Refer to *Fastener Caution on page 0-8*.

2. Install the BPMV bolts (1) and tighten to **8 N•m (71 lb in)**.
3. Install the BPMV assembly. Refer to *Brake Pressure Modulator Valve Replacement on page 5-76*.

Electronic Brake Control Module Replacement

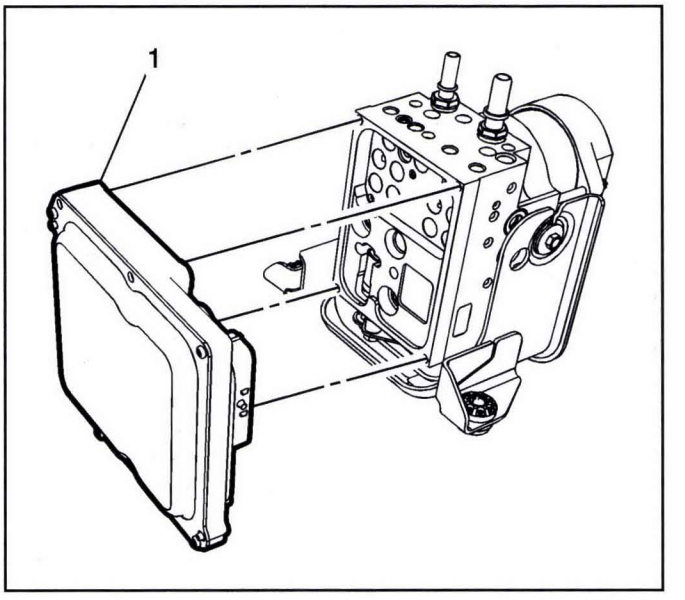
Removal Procedure

1. Remove the brake pressure modulator valve (BPMV) assembly. Refer to *Brake Pressure Modulator Valve Replacement on page 5-76*.



3226886

2. Remove the electronic brake control module (EBCM) bolts (1).



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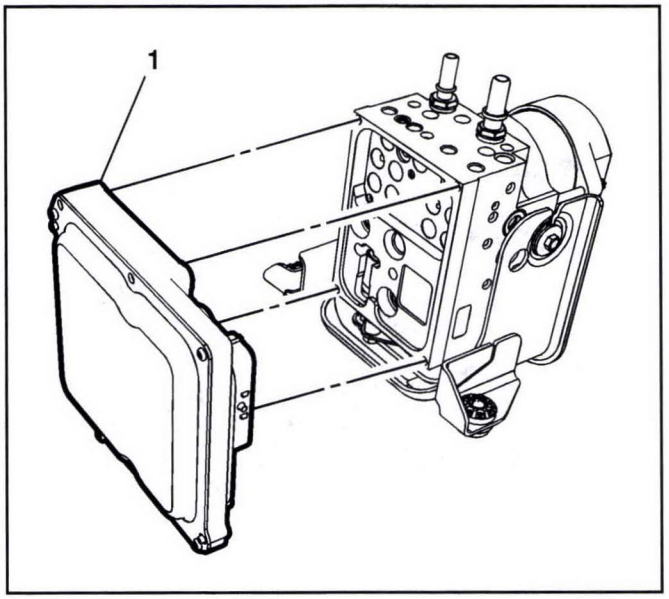
Note: Do not pry the EBCM from the BPMV. The EBCM must be pulled back evenly.

3. Carefully separate the EBCM (1) from the BPMV.

Installation Procedure

1. Clean the sealing surfaces of the EBCM and the BPMV with denatured alcohol and allow to dry.



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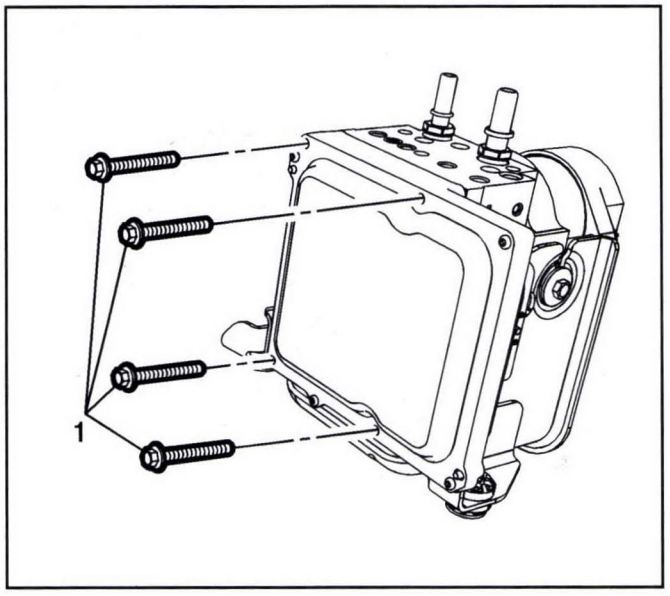
2. Install the EBCM (1) to the BPMV.



3226886

Caution: Refer to *Fastener Caution on page 0-8*.

3. Install the EBCM bolts (1) and tighten to **3** N•m **(27 lb in)**.
4. Install the BPMV assembly. Refer to *Brake Pressure Modulator Valve Replacement on page 5-76*.
5. Program the EBCM. Refer to *Electronic Brake Control Module Programming and Setup on page 6-9*.

Brake Control Brake Pedal Position Sensor Calibration

The brake controls brake pedal position sensor does not require calibration often. Calibration brake controls brake pedal position sensor might be required after certain service procedures are performed. Some of these procedures are as follows:

- Electronic brake control module (EBCM) replacement.
- Brake Control Brake Pedal Position Sensor replacement

The Brake Controls Brake Pedal Position Sensor Calibration procedure can be completed with a scan tool using the following steps:

1. Place the vehicle in Service Mode.
2. Place the transmission in PARK or neutral.
3. Do not apply the brake pedal.
4. Install the scan tool to the data link connector.
5. Select Brake Controls Offset Learn in the EBCM Configuration/Reset Functions list.
6. Follow the scan tool directions to complete the calibration procedure.
7. Clear any DTCs that may be set.

Brake Pressure Modulator Solenoid Valve Calibration

The brake pressure sensor does not require calibration often. Calibration of the brake pressure sensor might be required after certain service procedures are performed. Some of these procedures are as follows:

- Electronic brake control module (EBCM) replacement.
- Brake pressure modulator valve assembly replacement

The Brake Pressure Sensor Calibration procedure can be completed with a scan tool using the following steps:

1. Place the power button in the ON/RUN position.
2. Place the transmission in PARK
3. Release the brake pedal.
4. Install the scan tool to the data link connector.
5. Select Brake Pressure Sensor Calibration in the EBCM Configuration/Reset Functions list.
6. Follow the scan tool directions to complete the calibration procedure.
7. Clear any DTCs that may be set.

Brake Pressure Modulator Valve Replacement

Removal Procedure

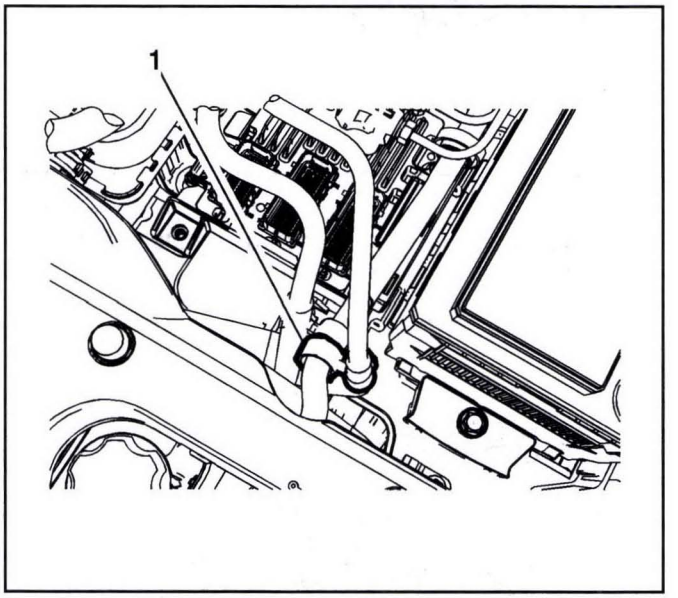
Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

Caution: Always connect or disconnect the wiring harness connector from the EBCM/EBTCM with the ignition switch in the OFF position. Failure to observe this precaution could result in damage to the EBCM/EBTCM.

Note: The transmission must be in the PARK position, the power button in the OFF position, and the brakes not applied to ensure the brake modulator and high pressure accumulator (HPA) pressure relief occurs. This process will take approximately 1 to 3 minutes.

1. Place the transmission in PARK.
2. Place the power button in the OFF position.
3. Remove the remote keyless entry (RKE) transmitter and close all of the vehicle doors.
4. Wait approximately 3 minutes for the HPA pressure relief to occur.
5. Remove the front bumper impact bar. Refer to *Front Bumper Impact Bar Replacement on page 3-55*.
6. Remove the drive motor battery coolant radiator assembly. Refer to *Drive Motor Battery Coolant Radiator Replacement on page 9-312*.



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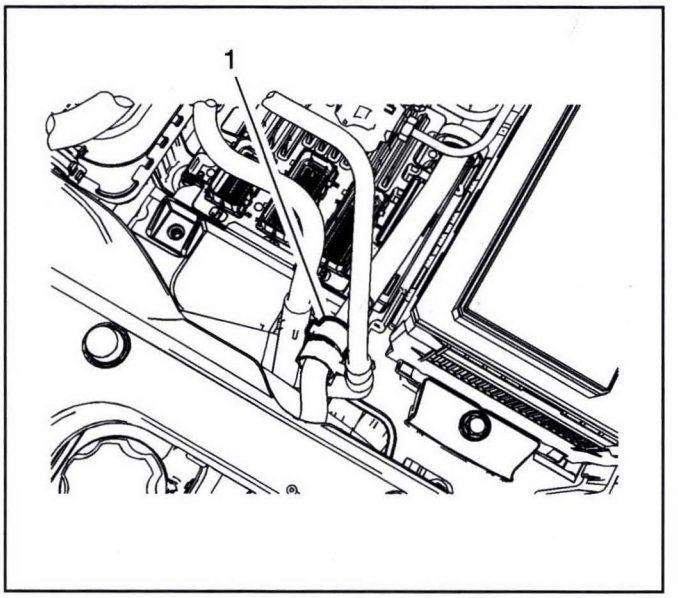
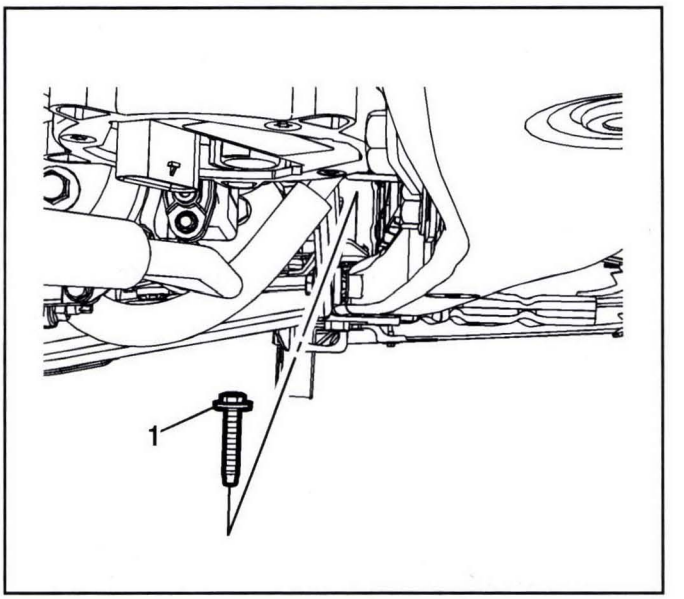
7. Release the brake pressure modulator valve return hose clip (1) from the differential drive motor cooling hose.



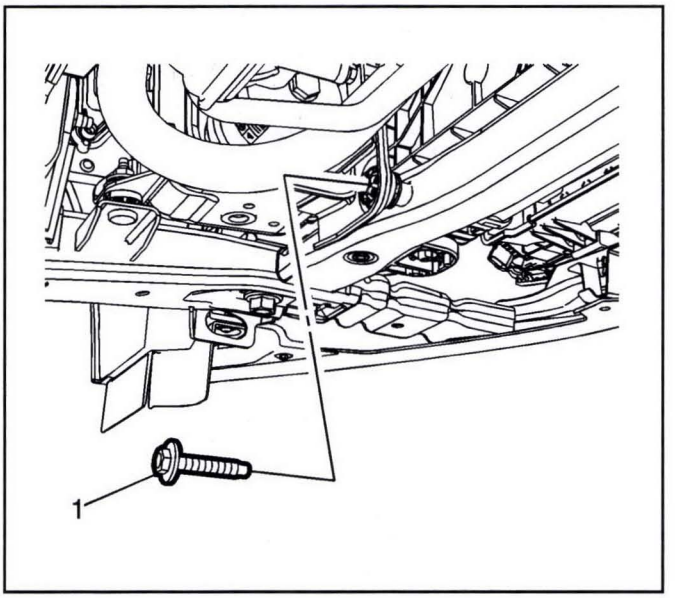
3220254

8. Release the brake pressure modulator valve feed hose clip (1) from the differential drive motor cooling hose.
9. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
10. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
11. Remove the left front compartment splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.
12. Disconnect the electronic brake control module (EBCM) electrical connector.



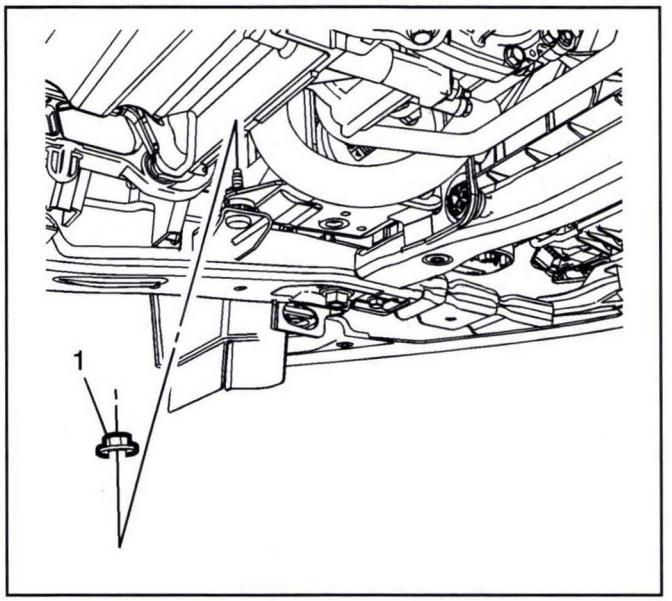
3226878

13. Remove the brake pressure modulator valve (BPMV) assembly upper bolt (1).



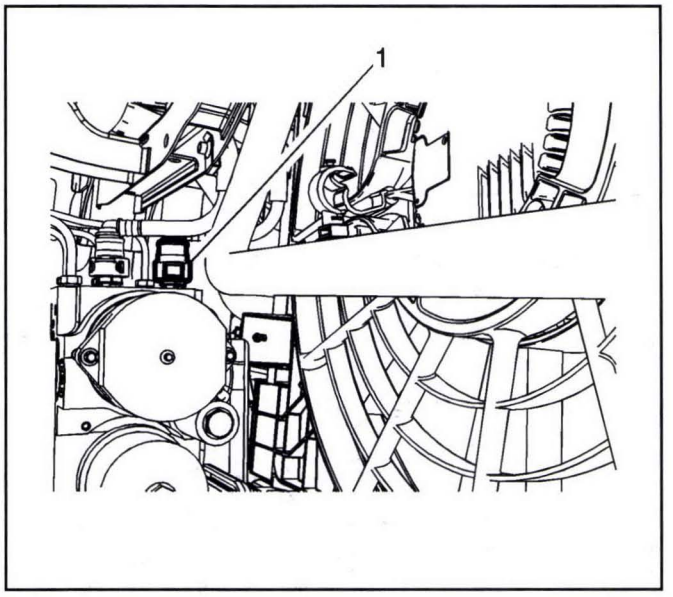
3226881

14. Remove the BPMV assembly lower bolt (1).



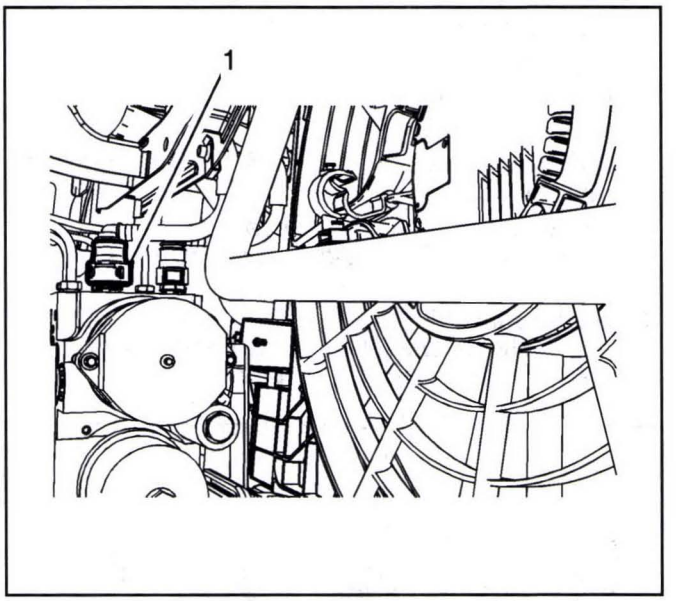
3226885

15. Remove the BPMV assembly nut (1).
16. Maneuver and position the BPMV assembly to allow access to the brake pipe and brake pressure modulator valve hose fittings and secure the BPMV assembly with heavy mechanics wire.



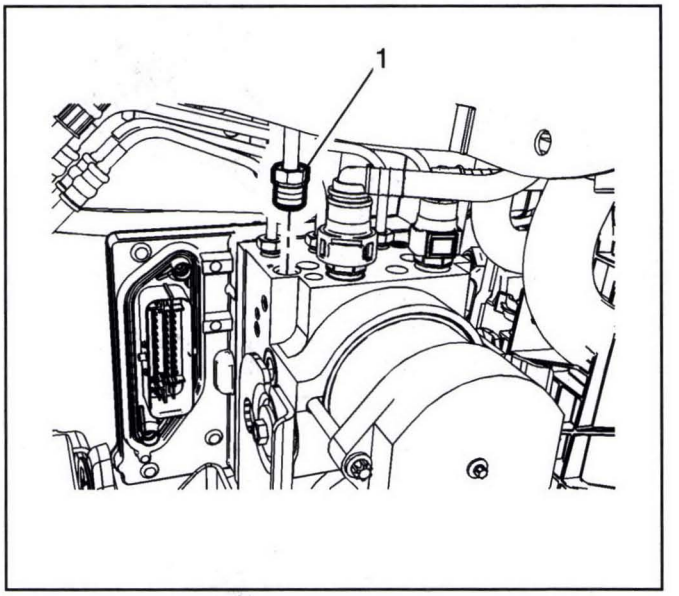
3220249

17. Disconnect the brake pressure modulator valve return hose quick connect (1).



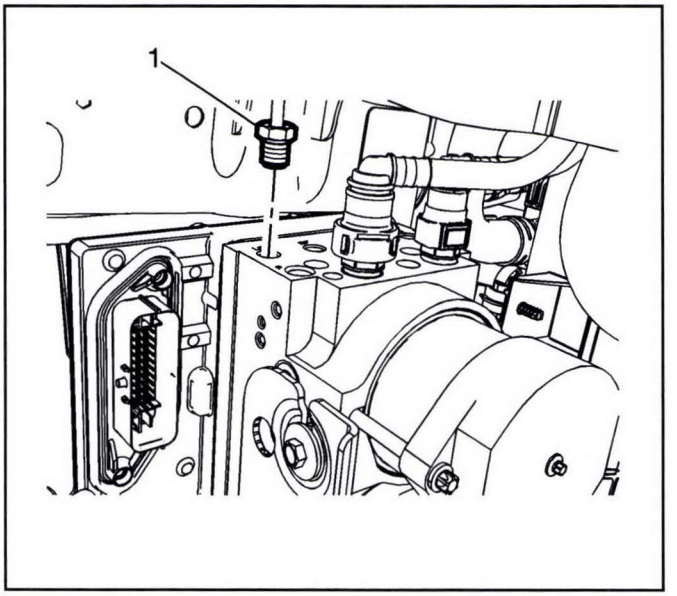
3220259

18. Disconnect the brake pressure modulator valve feed hose quick connect (1).



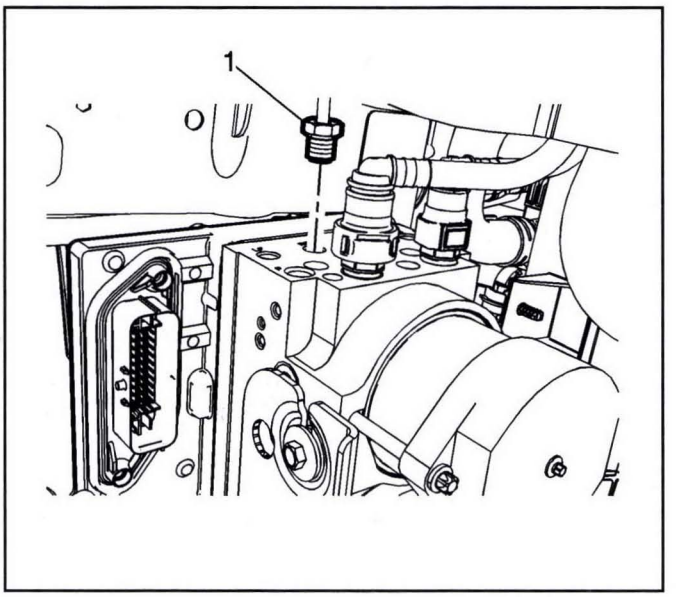
3222144

19. Disconnect the brake pressure modulator valve brake pipe fitting (1).
20. Cap the brake pipe fitting to prevent brake fluid loss and contamination.



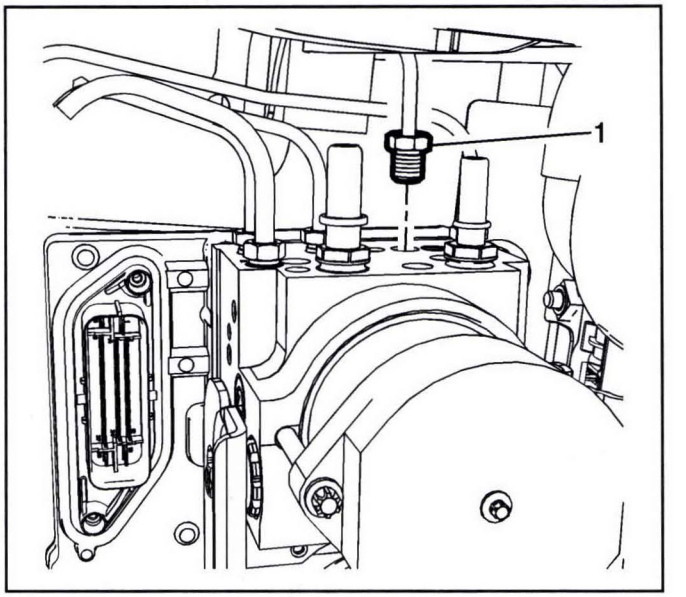
3222156

21. Disconnect the brake pressure modulator valve front brake pipe fitting (1).
22. Cap the brake pipe fitting to prevent brake fluid loss and contamination.



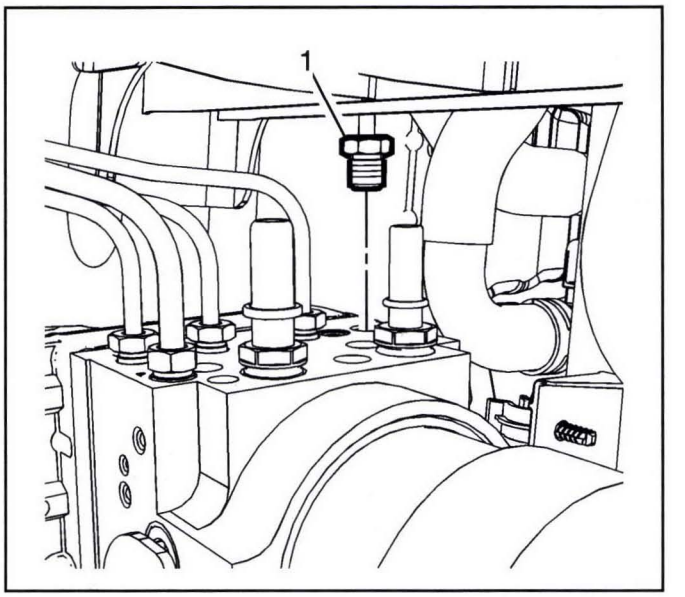
3222160

23. Disconnect the brake pressure modulator valve rear brake pipe fitting (1).
24. Cap the brake pipe fitting to prevent brake fluid loss and contamination.



3225833

25. Disconnect the rear brake front pipe left brake pipe fitting (1).
26. Cap the brake pipe fitting to prevent brake fluid loss and contamination.

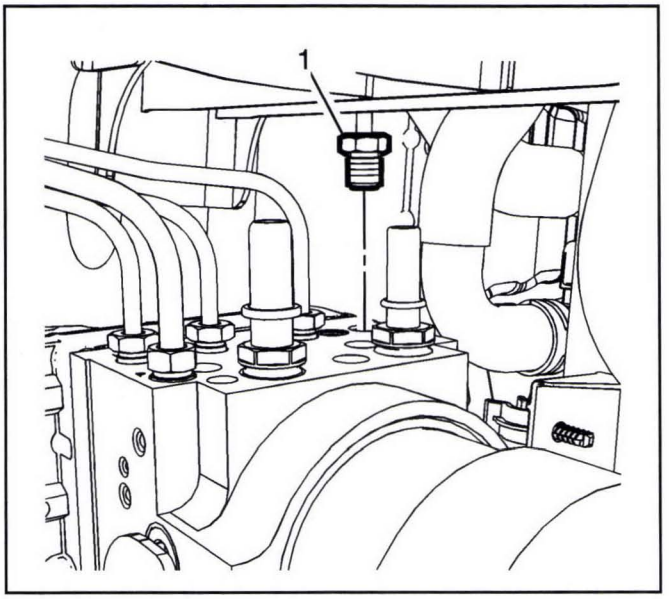


3225839

27. Disconnect the rear brake front pipe right brake pipe fitting (1).
28. Cap the brake pipe fitting to prevent brake fluid loss and contamination.
29. Remove the BPMV assembly from the vehicle.
30. If necessary, remove the EBCM. Refer to *Electronic Brake Control Module Replacement on page 5-75*.
31. If necessary, remove the BPMV bracket. Refer to *Brake Pressure Modulator Valve Bracket Replacement on page 5-83*.

Installation Procedure

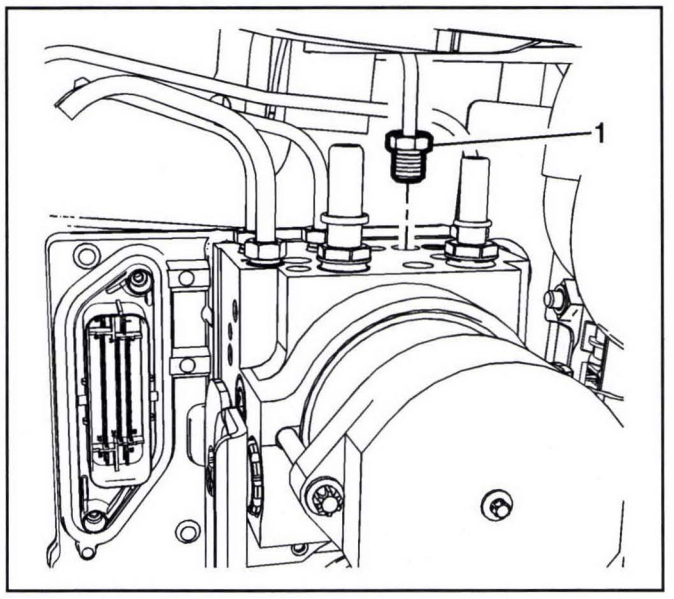
1. If removed, install the BPMV bracket. Refer to *Brake Pressure Modulator Valve Bracket Replacement on page 5-83*.
2. If removed, install the EBCM. Refer to *Electronic Brake Control Module Replacement on page 5-75*.
3. Install the BPMV assembly to the vehicle.



3225839

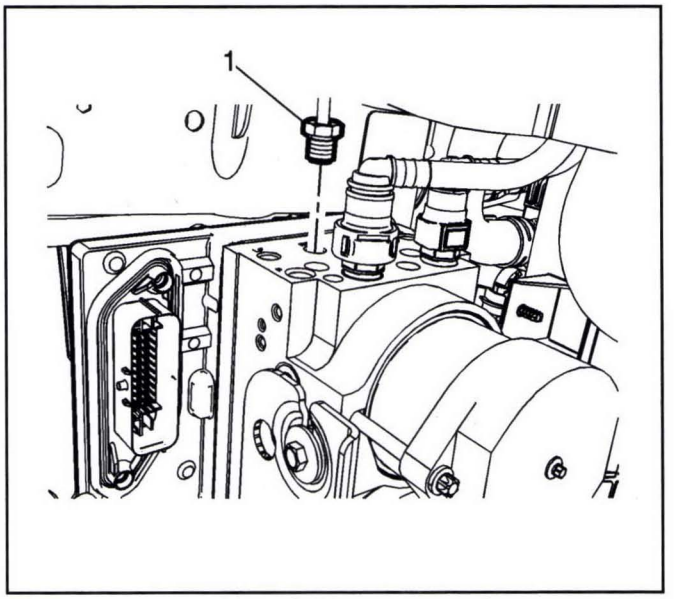
Caution: Refer to *Fastener Caution on page 0-8*.

4. Install the rear brake front pipe right brake pipe fitting (1) and tighten to **18 N•m (13 lb ft)**.



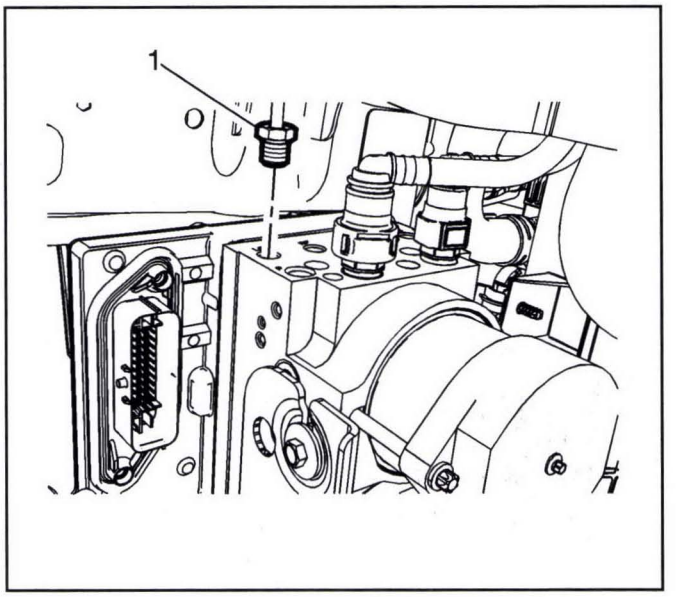
3225833

5. Install the rear brake front pipe left brake pipe fitting (1) and tighten to **18 N•m (13 lb ft)**.



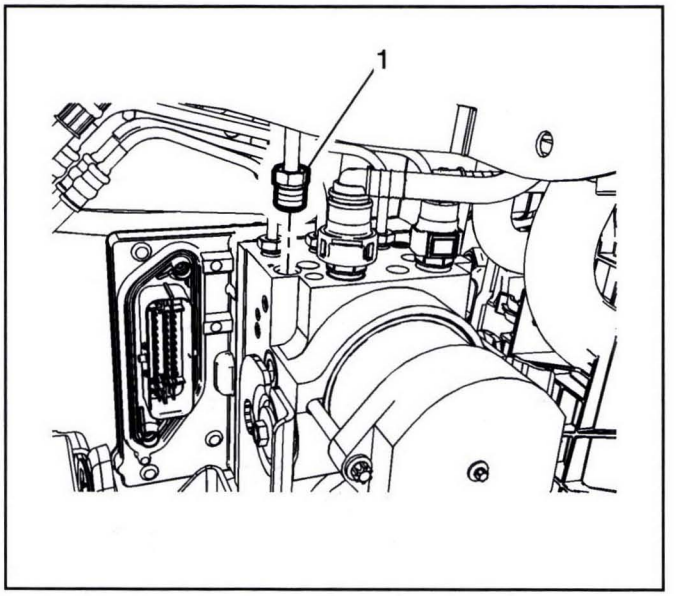
3222160

6. Install the brake pressure modulator valve rear brake pipe fitting (1) and tighten to **18 N•m (13 lb ft)**.



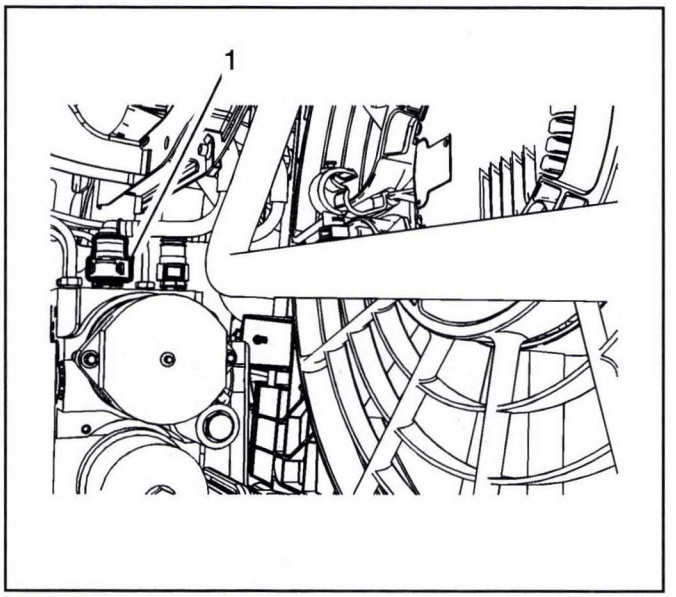
3222156

7. Install the brake pressure modulator valve front brake pipe fitting (1) and tighten to **18 N•m (13 lb ft)**.



3222144

8. Install the brake pressure modulator valve brake pipe fitting (1) and tighten to **18** N•m **(13 lb ft)**.



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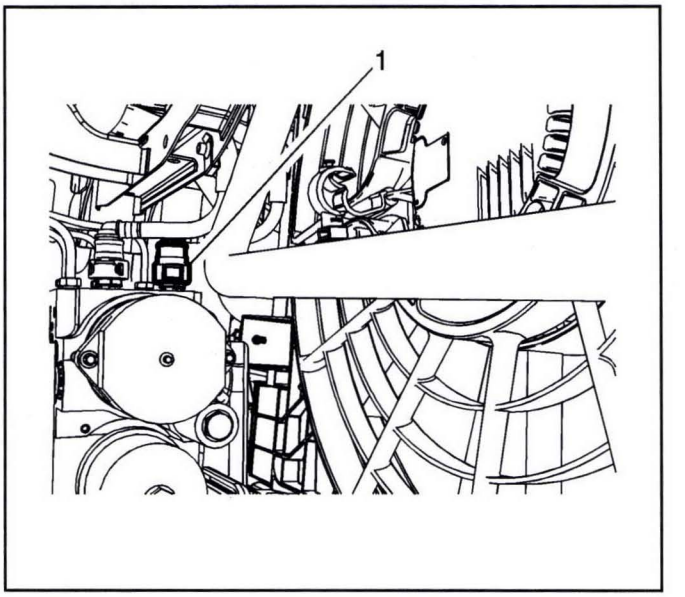
9. Connect the brake pressure modulator valve feed hose quick connect (1).



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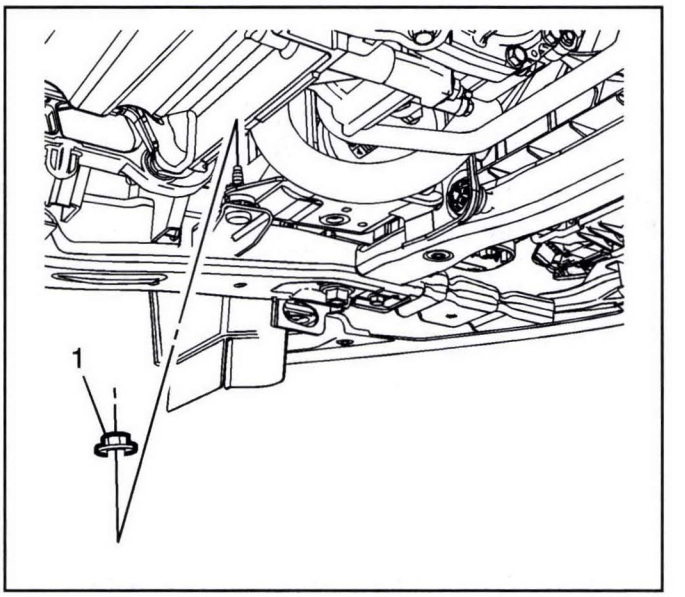
10. Connect the brake pressure modulator valve return hose quick connect (1).
11. Maneuver and position the BPMV assembly to the front cradle.



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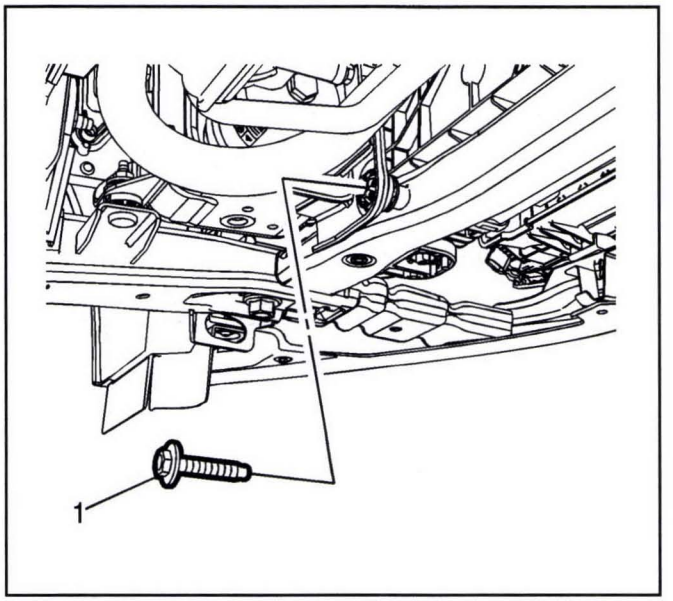
Note: Do not tighten the nut until instructed.

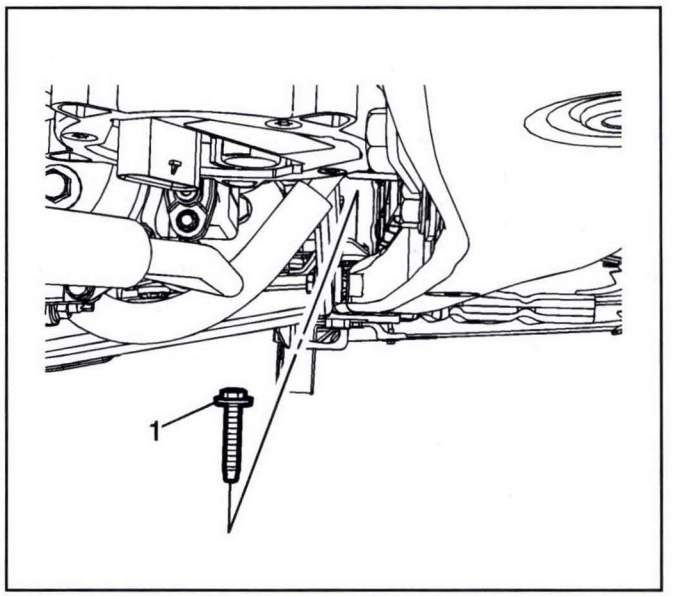
12. Loosely install the BPMV assembly nut (1).



3226881

Note: Do not tighten the bolt until instructed.

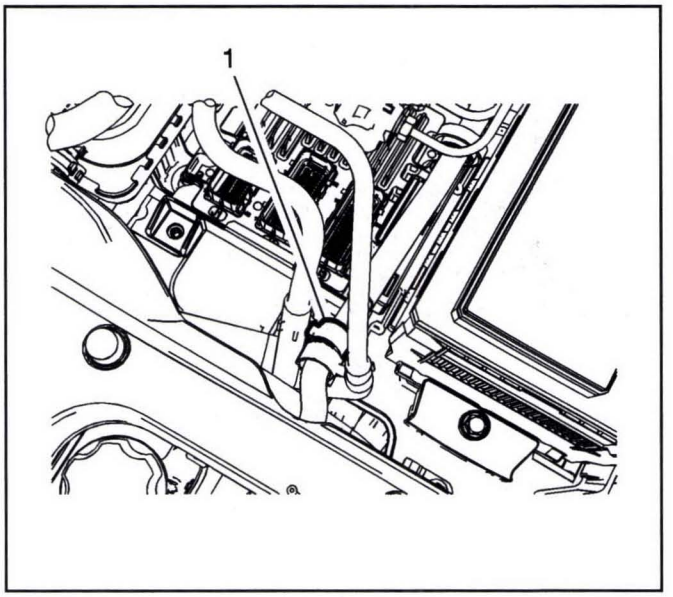
13. Loosely install the BPMV assembly lower bolt (1).



3226878

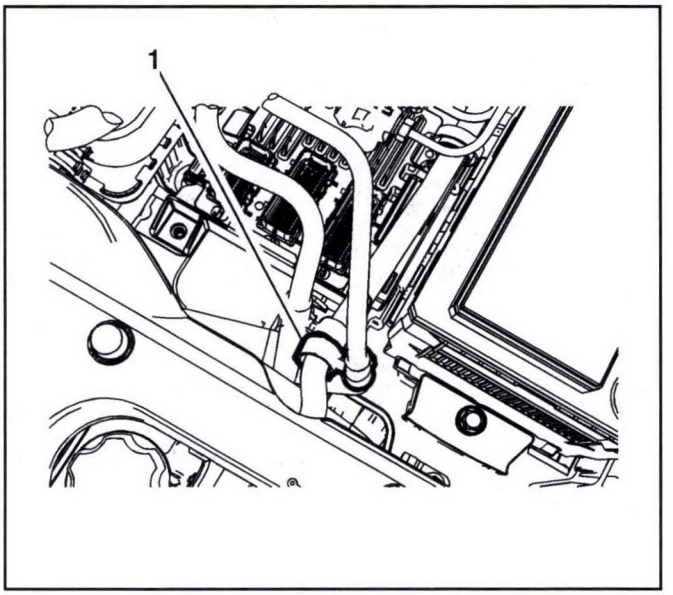
Note: Do not tighten the bolt until instructed.

14. Loosely install the BPMV assembly upper bolt (1).
15. Tighten the BPMV assembly nut to **22** N•m **(16 lb ft)**.
16. Tighten the BPMV assembly lower and upper bolts to **22** N•m **(16 lb ft)**.
17. Connect the EBCM electrical connector.
18. Install the left front compartment splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.
19. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
20. Lower the vehicle.
21. Install the drive motor battery coolant radiator assembly. Refer to *Drive Motor Battery Coolant Radiator Replacement on page 9-312*.
22. Install the front bumper impact bar. Refer to *Front Bumper Impact Bar Replacement on page 3-55*.



3220254

23. Secure the brake pressure modulator valve feed hose clip (1) to the differential drive motor cooling hose.



3220244

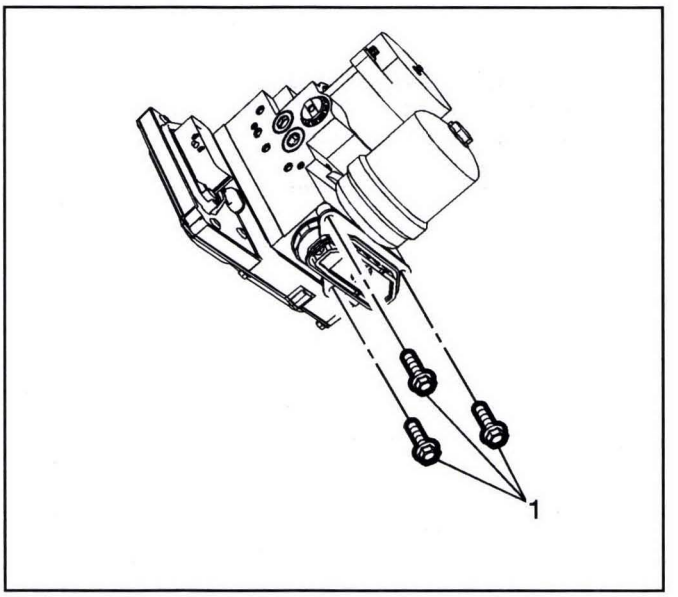
24. Secure the brake pressure modulator valve return hose clip (1) to the differential drive motor cooling hose.
25. If installing a new EBCM, program the EBCM. Refer to *Electronic Brake Control Module Programming and Setup on page 6-9*.

26. Perform the *Antilock Brake System Automated Bleed on page 5-72*. Follow the procedure completely to ensure the sensor and boost valve calibration and EBCM learn processes have been completed.
27. If necessary, calibrate the brake pressure modulator solenoid valve. Refer to *Brake Pressure Modulator Solenoid Valve Calibration on page 5-76*.

Brake Pressure Modulator Valve Bracket Replacement

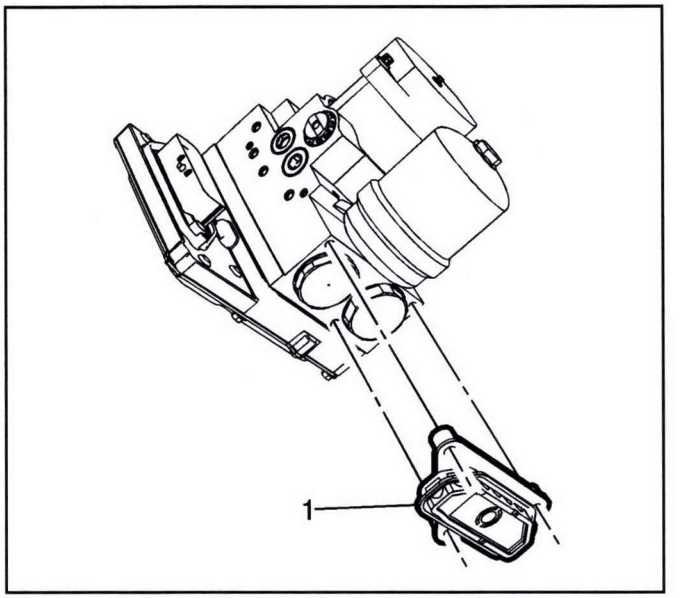
Removal Procedure

1. Remove the electronic brake and traction control module bracket. Refer to *Electronic Brake and Traction Control Module Bracket Replacement on page 5-74*.



3266916

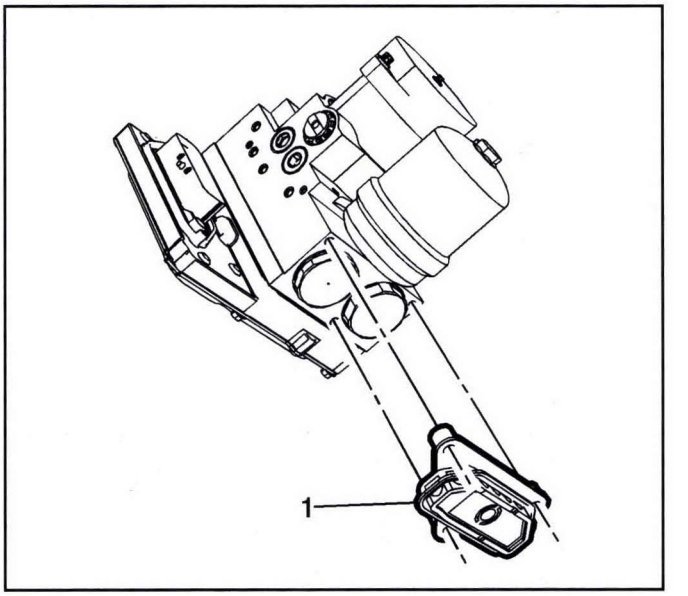
2. Remove the brake pressure modulator valve bracket bolts (1).



3266917

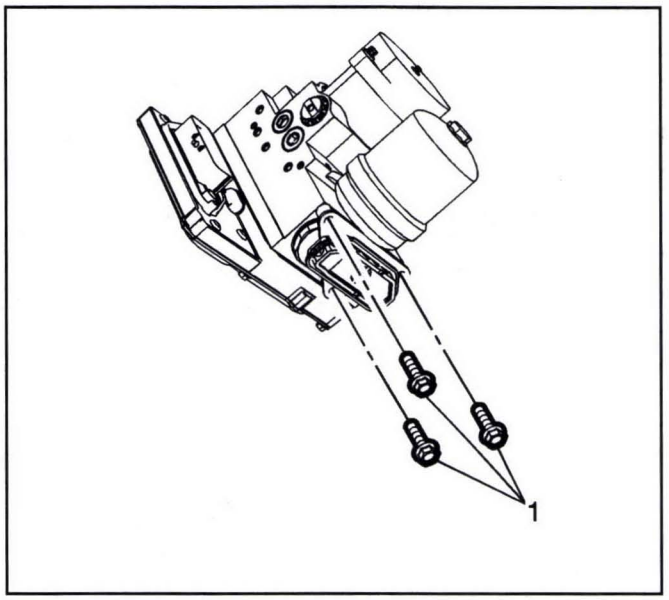
3. Remove the brake pressure modulator valve bracket (1).

Installation Procedure



3266917

1. Install the brake pressure modulator valve bracket (1).



3266916

Caution: Refer to *Fastener Caution on page 0-8*.

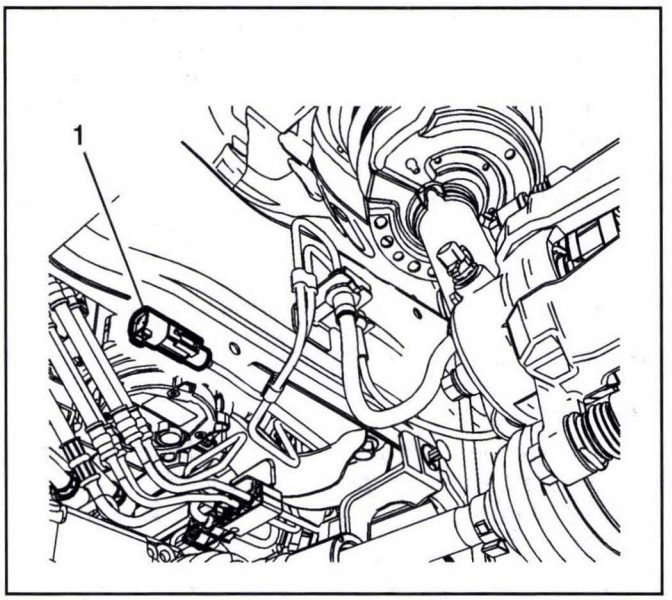
2. Install the brake pressure modulator valve bracket bolts (1) and tighten to **3 N•m (27 lb in)**.
3. Install the electronic brake and traction control module bracket. Refer to *Electronic Brake and Traction Control Module Bracket Replacement on page 5-74*.

Front Wheel Speed Sensor Replacement

Removal Procedure

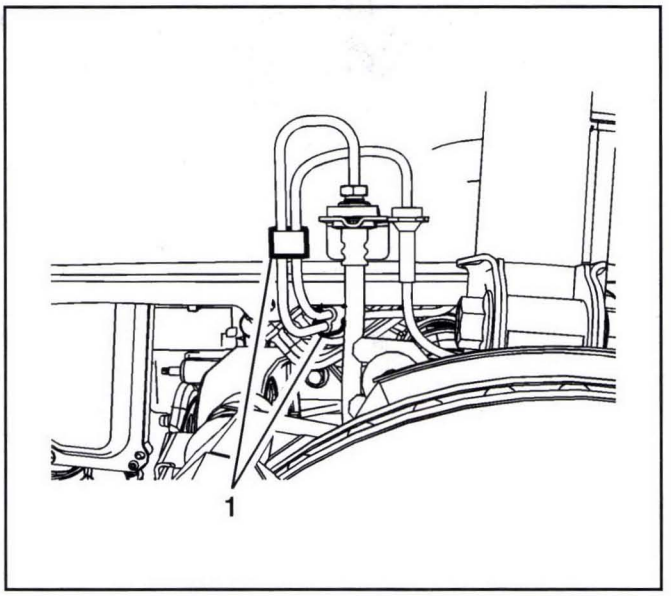
Warning: Refer to Brake Dust Warning on page 0-4.

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
3. Remove the front compartment front splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.



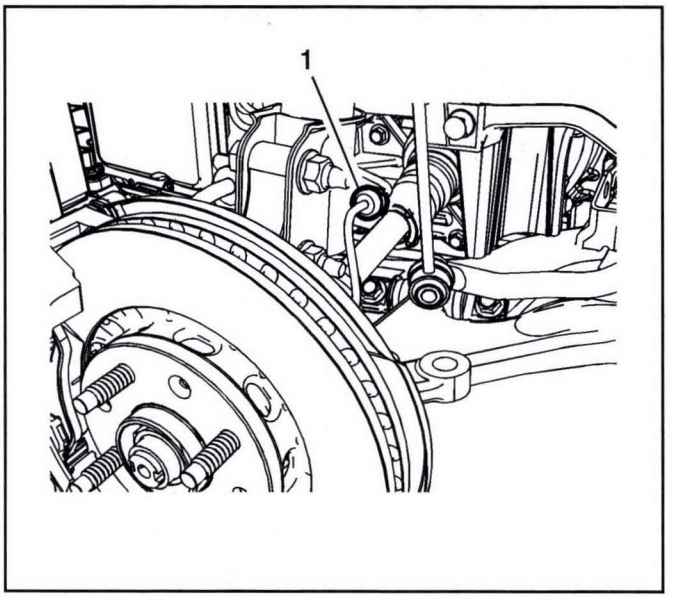
3227623

4. Disconnect the wheel speed sensor electrical connector (1) and release the connector from the front compartment side rail.



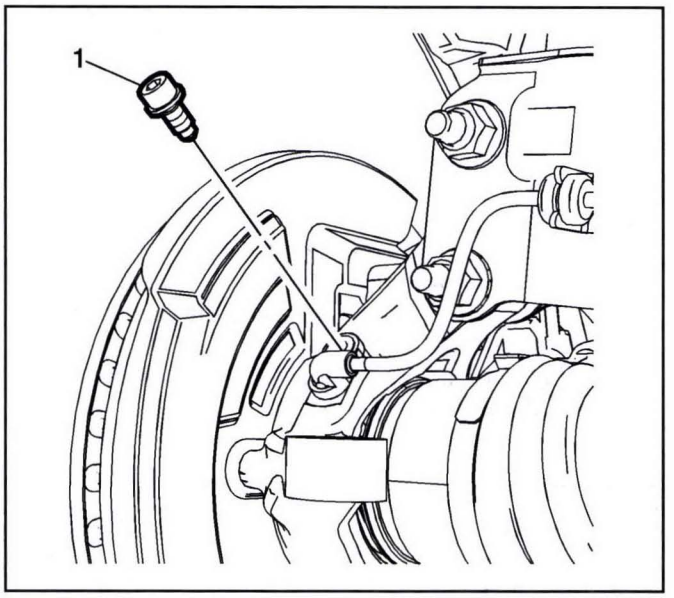
3223073

5. Release the wheel speed sensor harness clips (1) from the left front brake pipe.



3227624

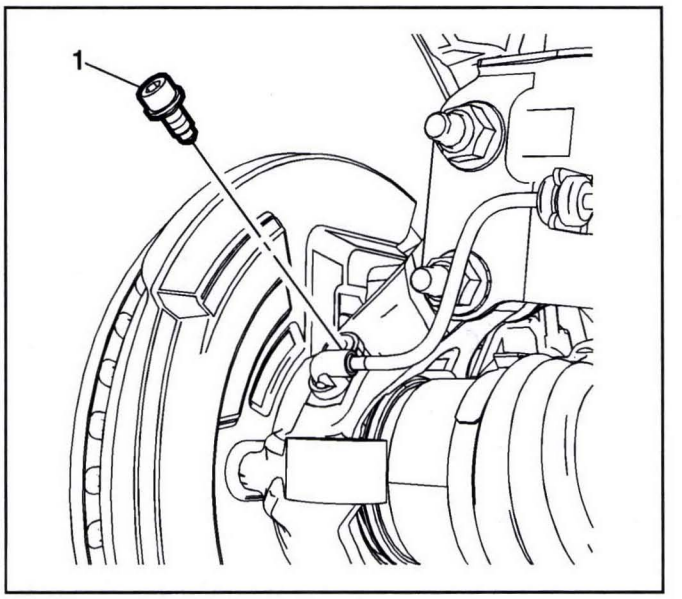
6. Release the front wheel speed sensor harness grommet (1) from the strut bracket.



3227626

7. Clean the wheel speed sensor mounting area on the steering knuckle of any accumulated dirt and debris.
8. Remove the wheel speed sensor bolt (1).
9. Remove the wheel speed sensor from the steering knuckle.

Installation Procedure

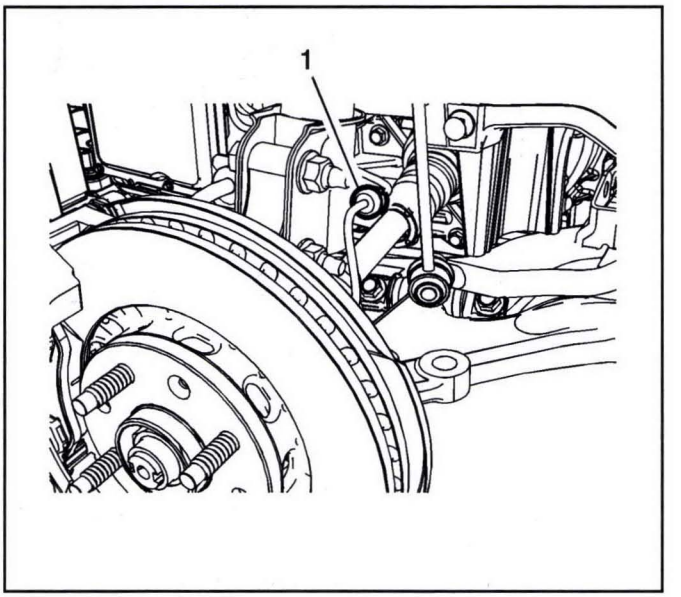


3227626

1. Install the wheel speed sensor to the steering knuckle.

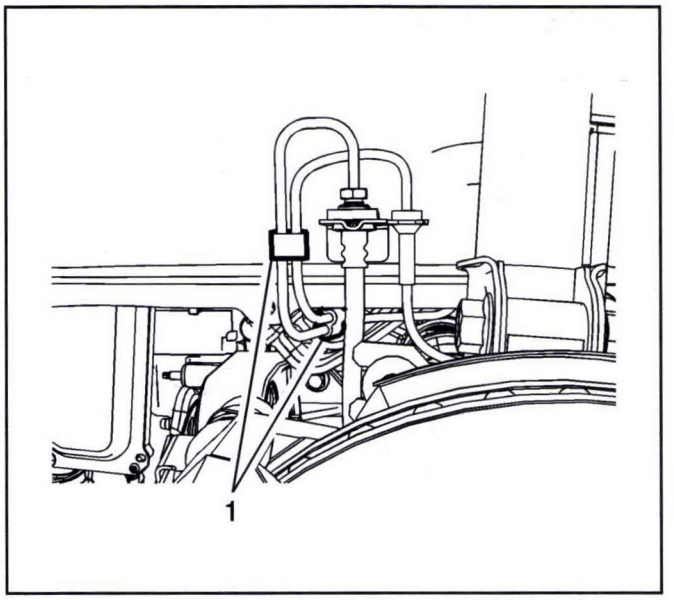
Caution: Refer to *Fastener Caution on page 0-8*.

2. Install the wheel speed sensor bolt (1) and tighten to **8** N•m **(71 lb in)**.



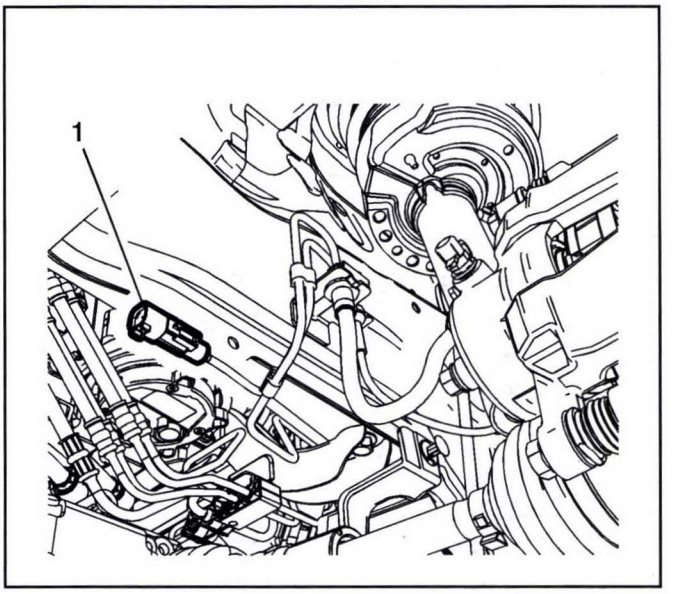
3227624

3. Install the front wheel speed sensor harness grommet (1) to the strut bracket.



3223073

4. Install the wheel speed sensor harness clips (1) to the left front brake pipe.



3227623

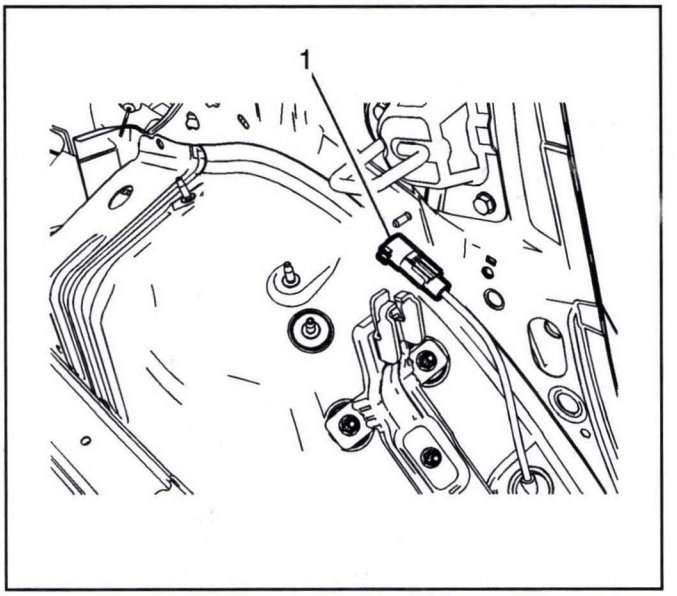
5. Connect the wheel speed sensor electrical connector (1) and install the connector to the front compartment side rail.
6. Install the front compartment front splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.
7. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
8. Perform the *Diagnostic System Check - Vehicle on page 6-91*.

Rear Wheel Speed Sensor Replacement

Removal Procedure

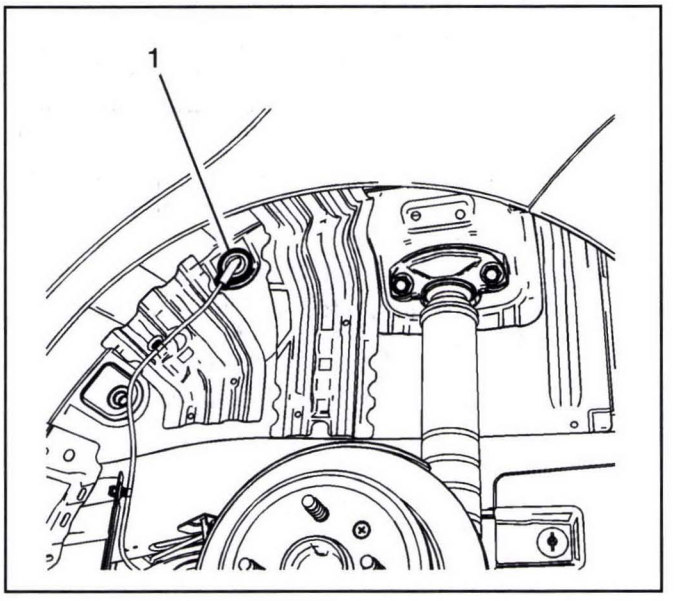
Warning: Refer to Brake Dust Warning on page 0-4.

1. Remove the quarter lower rear trim panel. Refer to *Quarter Lower Rear Trim Panel Replacement on page 2-65*.



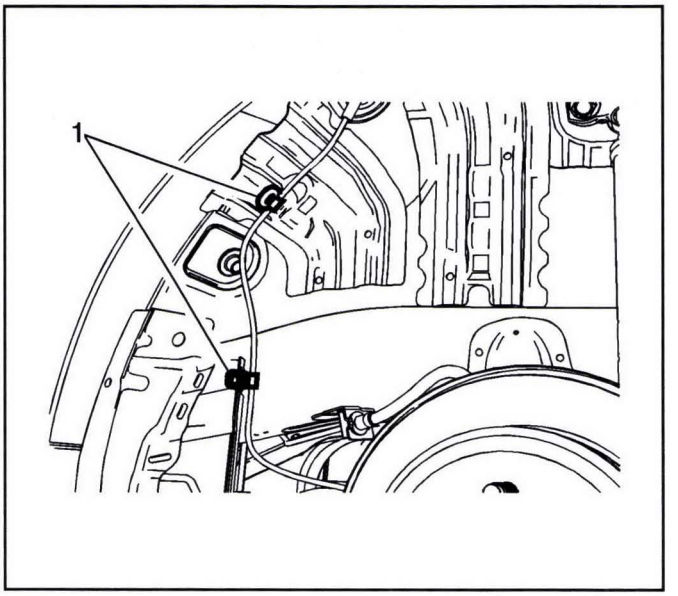
3227686

2. Disconnect the rear wheel speed sensor connector (1) and release the connector retainer from the rear wheelhouse.
3. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
4. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.



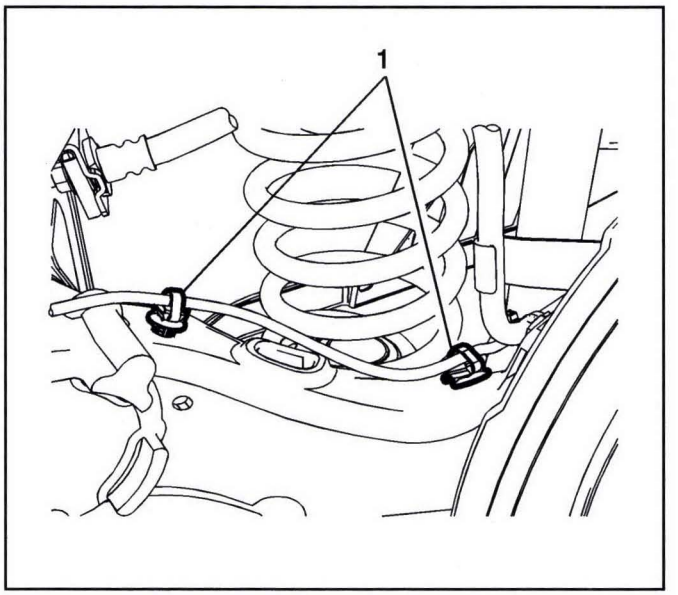
3227691

5. Release the rear wheel speed sensor grommet (1) from the rear wheelhouse panel.
6. Carefully feed the harness and connector through the rear wheelhouse panel.



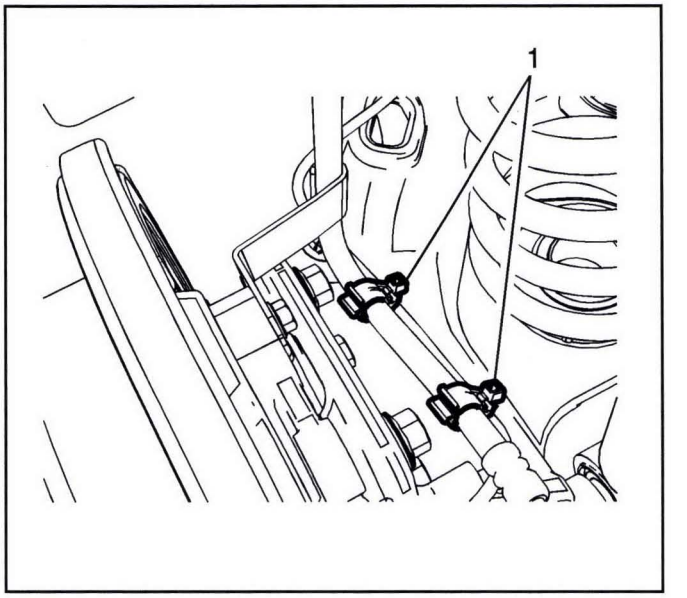
3227694

7. Release the rear wheel speed sensor harness from the clips (1) on the rear wheelhouse panel.



3227699

8. Release the rear wheel speed sensor harness from the rear axle clips (1).

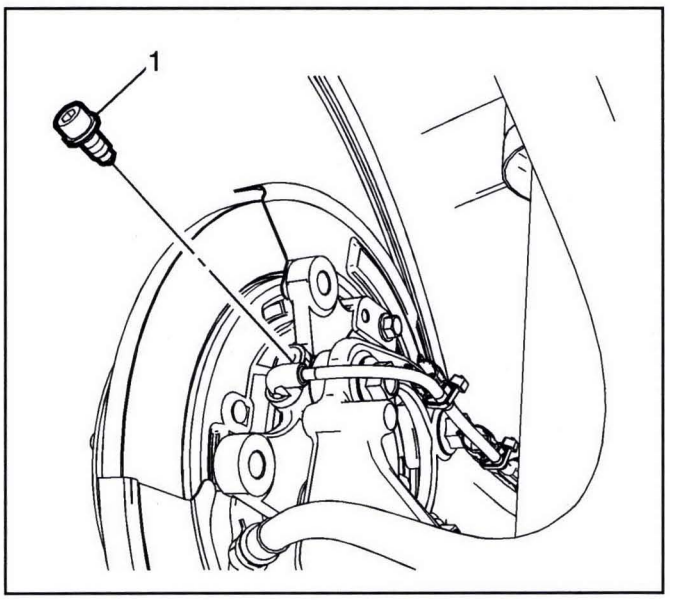


3227704

9. Release the rear wheel speed sensor harness clips (1) from the rear brake hose.

Caution: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

10. Without disconnecting the hydraulic brake flexible hose, remove the rear brake caliper and support with heavy mechanics wire. Refer to *Rear Brake Caliper Replacement on page 5-109*.
11. Clean the wheel speed sensor mounting area on the suspension knuckle of any accumulated dirt and debris.

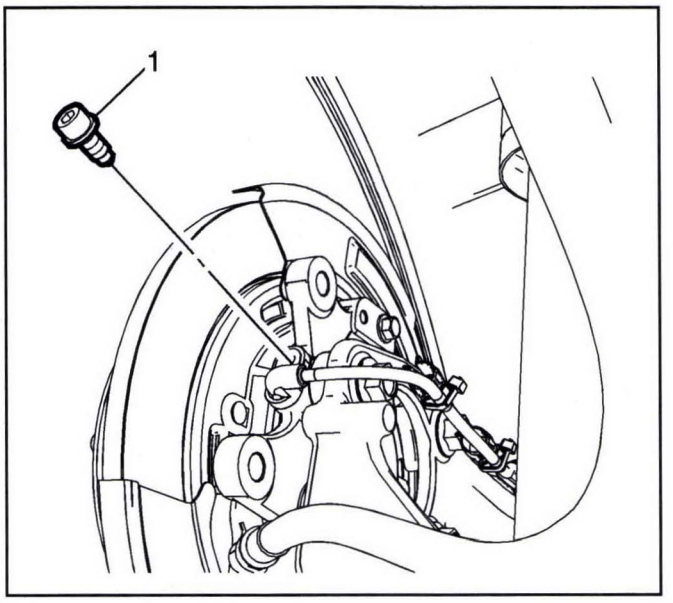


3227708

12. Remove the wheel speed sensor bolt (1).

13. Remove the wheel speed sensor from the parking brake anchor plate and remove the wheel speed sensor.

Installation Procedure

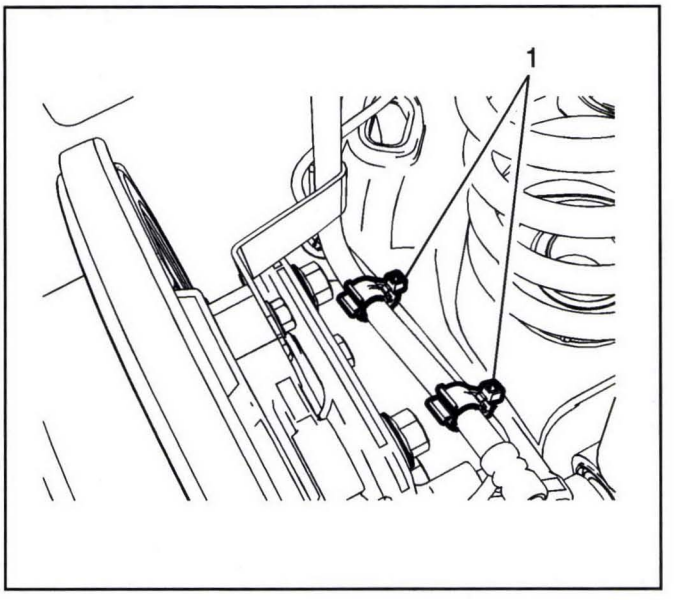


3227708

1. Install the wheel speed sensor to the parking brake anchor plate.

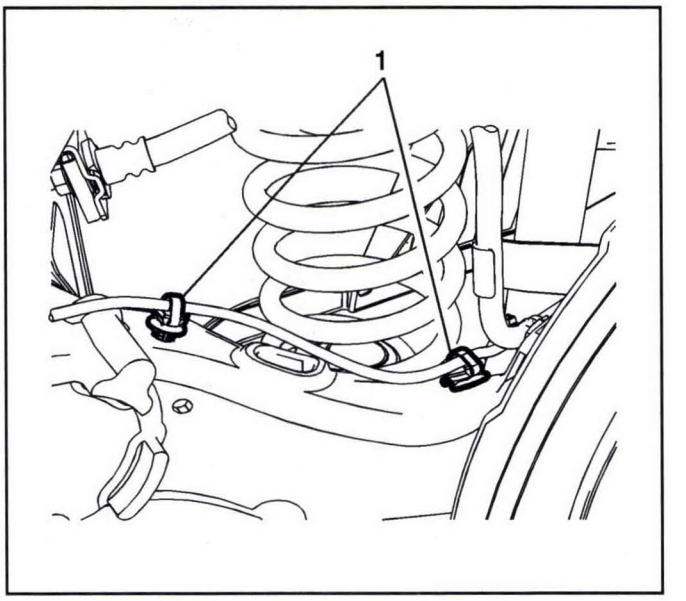
Caution: Refer to *Fastener Caution on page 0-8*.

2. Install the wheel speed sensor bolt (1) and tighten to **8 N•m (71 lb in)**.
3. Install the rear brake caliper. Refer to *Rear Brake Caliper Replacement on page 5-109*.



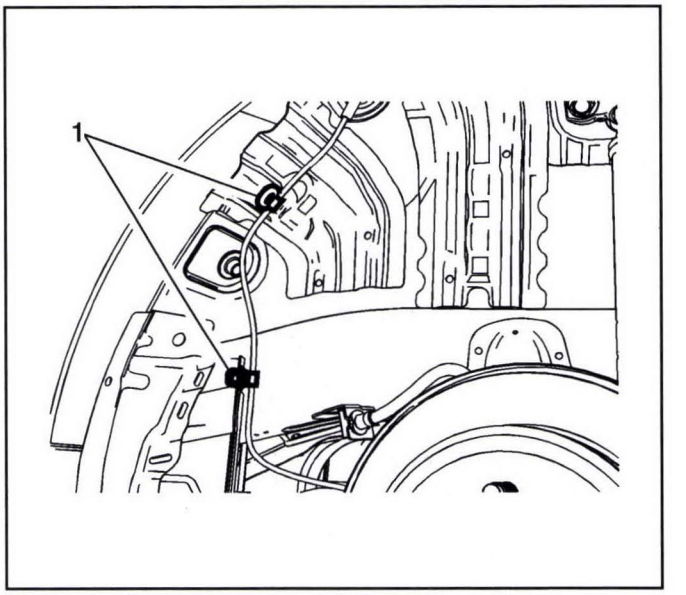
3227704

4. Install the rear wheel speed sensor harness clips (1) to the rear brake hose.



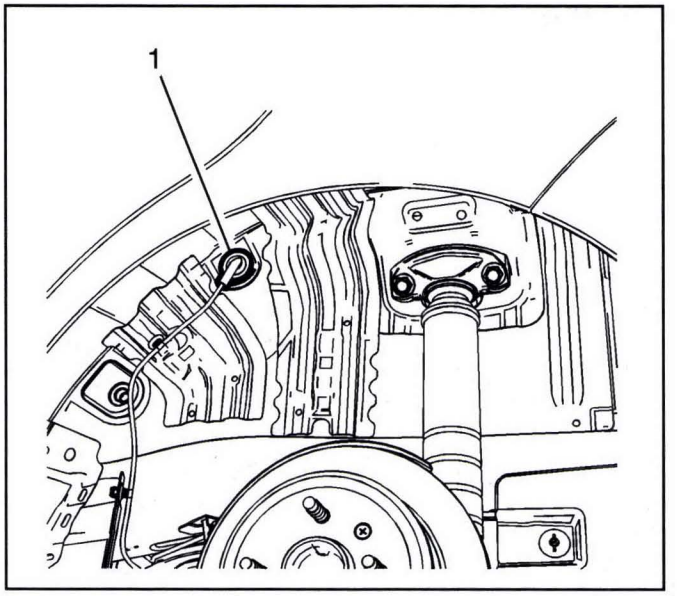
3227699

5. Install the rear wheel speed sensor harness to the rear axle clips (1).

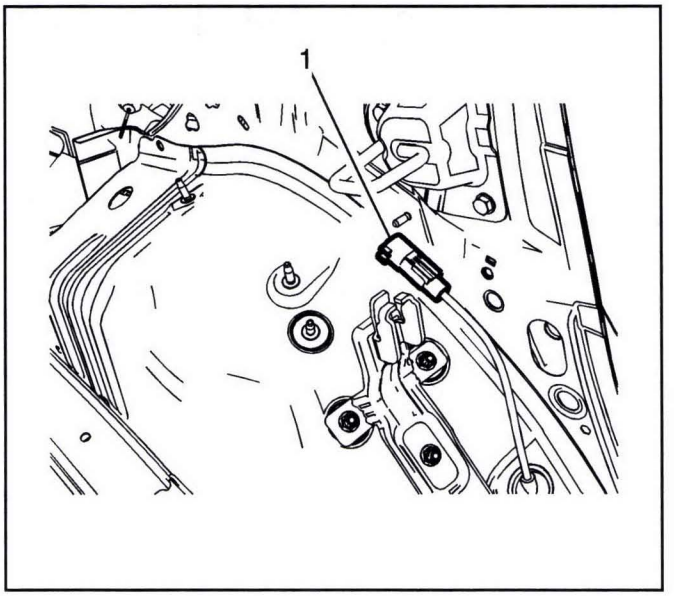


3227694

6. Install the rear wheel speed sensor harness to the clips (1) on the rear wheelhouse panel.



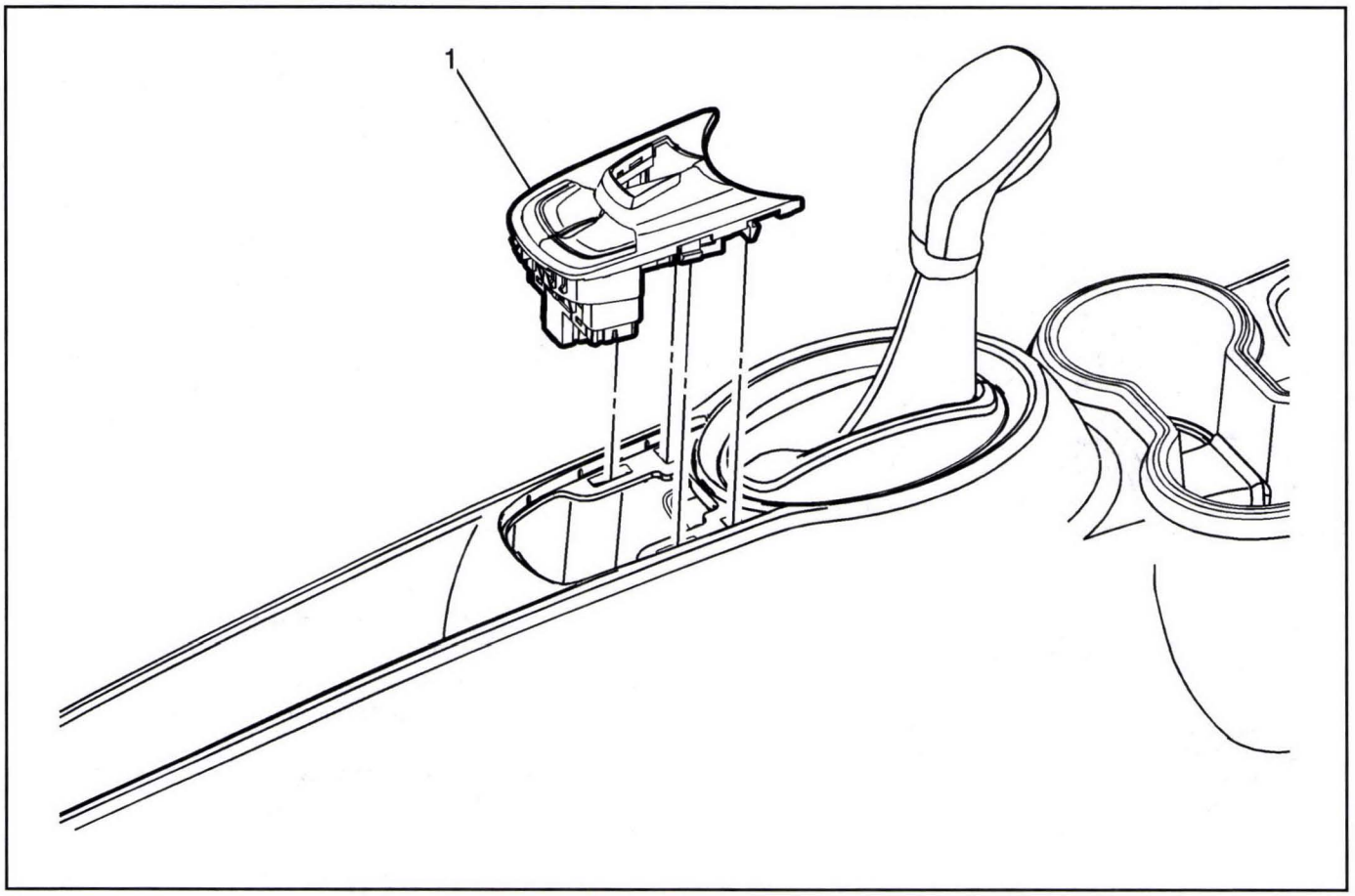
3227691



3227686

7. Carefully feed the harness and connector through the rear wheelhouse panel.
8. Secure the rear wheel speed sensor grommet (1) into the rear wheelhouse panel.
9. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
10. Lower the vehicle.
11. Connect the rear wheel speed sensor connector (1) and install the connector retainer to the rear wheelhouse.
12. Install the quarter lower rear trim panel. Refer to *Quarter Lower Rear Trim Panel Replacement on page 2-65*.
13. Perform the *Diagnostic System Check - Vehicle on page 6-91*.

Vehicle Stability Control System Switch Replacement



3212636

Vehicle Stability Control System Switch Replacement

Callout	Component Name
Preliminary Procedure Remove the front floor console. Refer to *Front Floor Console Replacement on page 2-48*.	
1	Vehicle Stability Control System Switch **Procedure** 1. Using the appropriate tool depress the tabs on the switch and gently remove. 2. Disconnect the electrical connector.

Vehicle Yaw Sensor Learn

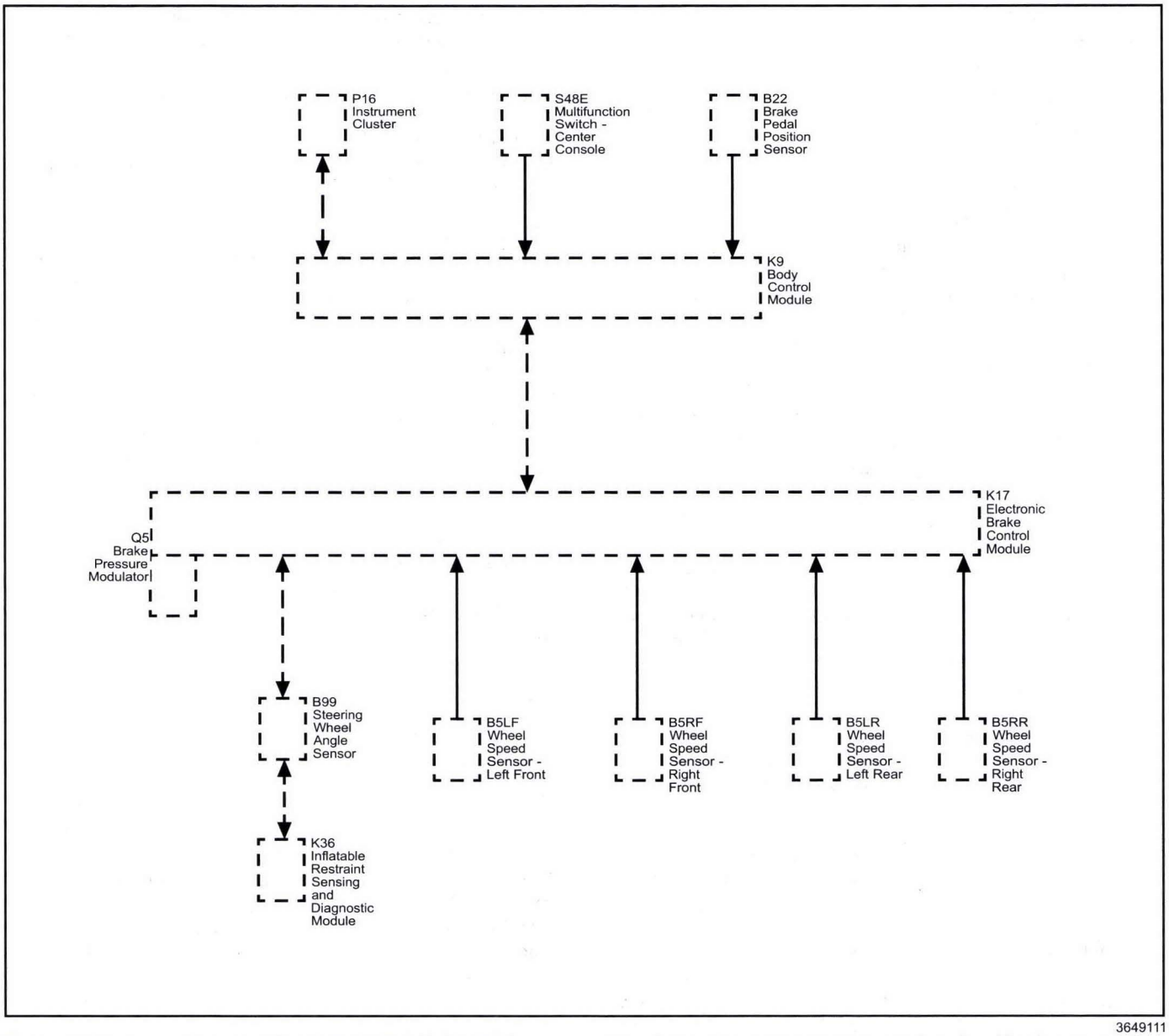
The yaw rate sensor learn procedure can be completed with a scan tool using the following steps:

1. Place vehicle on a level surface
2. Apply the parking brake, or set the transmission in the P position.
3. Install the scan tool to the data link connector.
4. Ignition ON, engine OFF.
5. Select Yaw Rate Sensor Learn in the Electronic Brake Control Module Configuration/Reset Functions list.
6. Follow the scan tool directions to complete the calibration procedure.
7. Clear any DTCs that may be set.

Description and Operation

ABS Description and Operation

ABS Block Diagram



3649111

This vehicle is equipped with a TRW ABS/SCB/TC/VSC module.

This module provides the following vehicle performance enhancement systems:

- ABS
- Electronic Brake Distribution
- Hill Start Assist
- Master Cylinder Assembly
- Slip Control Boost
- Traction Control
- Vehicle Stability Control

The following components are involved in the operation of the above systems:

- Electronic brake control module (EBCM)—The EBCM controls the system functions and detects failures.

  The EBCM contains the following components:

  – System relay—The system relay is internal to the EBCM. The system relay is energized when placed in Vehicle ON, Vehicle in Service Mode or a remote function actuation commands remote START. The system relay supplies battery positive voltage to the valve solenoids and to the ABS pump motor. This voltage is referred to as system voltage.

  - Solenoids—The solenoids are commanded ON and OFF by the EBCM to operate the appropriate valves in the brake pressure modulator.
- Brake pressure modulator—The brake pressure modulator uses a four circuit configuration to control hydraulic pressure to each wheel independently.

  The brake pressure modulator contains the following components:
  - ABS pump motor and pump
  - Isolation valves
  - Dump valves
  - High pressure accumulator
  - Electronic hydraulic control unit
- Steering Wheel Angle Sensor – The EBCM receives serial data message inputs from the steering wheel angle sensor that is integral to the electric power steering unit. The steering wheel angle signal is used to calculate the driver intended driving direction.
- Traction control switch–Traction control and stability control are manually disabled or enabled by pressing the traction control switch.
- Multi-axis acceleration sensor in vehicles equipped—The yaw rate, lateral acceleration and longitudinal acceleration sensors are combined into one multi-axis acceleration sensor, internal to the inflatable restraint sensing and diagnostic module. The EBCM receives serial data message inputs from the yaw rate, lateral acceleration and longitudinal acceleration sensor and activates stability control depending on multi-axis acceleration sensor input.
- Wheel speed sensors—The wheel speeds are detected by active wheel speed sensors and encoder rings. The encoder ring consists of permanent magnets. Each wheel speed sensor receives ignition voltage from the EBCM and provides a DC square wave signal back to the module. As the wheel spins, the EBCM uses the frequency of the square wave signal to calculate the wheel speed.

Initialization Sequence

The electronic brake control module performs one initialization test each ignition cycle. The initialization of the electronic brake control module occurs when both the following conditions occur:

- The vehicle speed is greater than 20 km/h (12 MPH).
- The stop lamp switch is not applied.

The initialization sequence cycles each solenoid valve and the pump motor, as well as the necessary relays, for approximately 1.5 seconds to check component operation. The electronic brake control module sets a DTC if any error is detected. The initialization sequence may be heard and felt while it is taking place, and is considered part of normal system operation.

The electronic brake control module defines a drive cycle as the completion of the initialization sequence.

Electronic Brake Distribution

The electronic brake distribution is a control system that replaces the hydraulic proportioning function of the mechanical proportioning valve in the base brake system. The electronic brake distribution control system is part of the operation software in the electronic brake control module. The electronic brake distribution uses active control with existing ABS in order to regulate the vehicle's rear brake pressure.

The red brake warning indicator is illuminated when the electronic brake distribution function is disabled.

Hill Start Assist

Note: The hill start assist feature will not operate if the stability control is disabled.

Some vehicles are equipped with the hill start assist technology feature. When stopped on a hill, the hill start assist feature prevents the vehicle from rolling before driving off, whether facing uphill or downhill by holding the brake pressure during the transition between when the driver releases the brake pedal and starts to accelerate. The electronic brake control module calculates the brake pressure, which is needed to hold the vehicle on an incline or grade greater than 5% and locks that pressure for up to two seconds by commanding the appropriate solenoid valves ON and OFF when the brake pedal is released. The stop lamps will stay illuminated during the hill-hold operation even though the brake pedal is released, this is considered normal operation.

The hill start assist feature is determined by the electronic brake control module using the following inputs:

- Accelerator pedal position sensor
- Brake pedal position sensor
- Multi-axis acceleration sensor

Slip Control Boost Overview

The slip control boost system is a hydraulic braking system which is capable of supplying boosted braking, slip control functions, and regenerative brake blending.

The system is made up of two major assemblies, the master cylinder assemble (no vacuum booster is used), and the electro-hydraulic control unit. Also included are various internal and external sensors used for system control and fault isolation.

The master cylinder assembly is made up of a reservoir and a master cylinder with primary and secondary pistons.

The electro-hydraulic control unit is used to electronically control pressure at the wheels. A pump and accumulator supply hydraulic brake fluid pressure to perform braking applications. A proportional supply valve controls the flow and pressure of fluid from the accumulator to the brakes. Standard digital slip control valves and, in some cases, proportional versions of them, are used to control pressures at the brakes independently for slip control. The regenerative axle isolation valves along with the proportional relief valve are used in regenerative brake blending situations. A simulator, consisting of a plunger, spring, orifice, and check valve provide the force and travel feedback to the driver through the master cylinder. There are four

internal pressure transducers, master cylinder pressure, high pressure accumulator, boost pressure, and regenerative axle circuit pressure sensors.

General Operation

The driver applies the pedal and thereby builds pressure in the primary chamber of the master cylinder with the primary piston. The fluid from the primary chamber is transmitted from the master cylinder by the brake tube to the electro-hydraulic control unit through the orifice and check valve and into the simulator chamber. With the slip control boost system active and working normally, the fluid from the primary master cylinder chamber does not get applied to the wheel brakes but to the simulator. The pedal simulator spring, the orifice, and the check valve combine to affect a force/travel characteristic that feels smooth, normal, and controllable to the driver. A pressure transducer on the primary master cylinder chamber/pedal simulator (Master Cylinder Pressure), a pedal travel sensor on the input piston assembly, and the brake switch are inputs into the electronic control unit. These inputs are used to determine the driver's braking intent which is used to control the torque applied to the wheels.

Base Brakes (Friction Braking)

The braking torque applied to the wheels in proportion to the driver's braking intent is achieved with a combination of regenerative braking from the powertrain and hydraulically applied friction braking controlled by the electro-hydraulic control unit. The friction braking is achieved by the electro-hydraulic control unit controlling a combination of valves in a way that allows accumulator pressure to be used to actuate the wheel brakes. The accumulator is maintained at pressure during normal operation by the pump and motor, independent of the brake being applied. The pressure built in the braking circuits by the electro-hydraulic control unit by means of the boost valve is applied directly to the rear brakes. The front circuit pressure, however, are applied to the master cylinder secondary pistons, and they in turn apply pressure to the front while brakes. The slip control boost system is designed and used with its electro-hydraulic control unit and master cylinder primary and secondary pistons configured as they are for fail-safe purposes.

Fail-Safe System Operation (Four or Two Wheel Push Through)

With the system active, and working normally, the normally open and normally closed valves become active when the driver steps on the pedal, and friction braking is desired. This opens up the simulator to the fluid input from the master cylinder, and allows the boost valve to build pressure in the boost circuit that will actuate the wheel brakes. If the brake is applied with no power, or if the system detects a critical failure, these valves are not energized, resulting in a fail-safe system operation (push through) that allows the driver to push primary chamber fluid directly into the braking/boost circuits of all four wheels (four wheel push through). If a hydraulic failure occurs in the boost circuit a further pedal input will result in the primary piston of the master cylinder directly contracting the secondary pistons and applying pressure to the front hydraulic circuits (two wheel push through). Slip control functions are done by controlling the four isolation valves and the four dump valves in a manner common to how slip control functions are done in standard systems and is not described here.

Regenerative Brake Blending

Regenerative brake blending is done by using the driver braking intent information to request a powertrain braking torque, by receiving feedback about how much powertrain torque is applied, and controlling wheel brake pressures to fulfill the braking desired along with the powertrain regenerative pressure applied. To maximize the regenerative powertrain energy recovery during braking (while still maintaining suitable brake balance), the rear brake pressures may be reduced as compared proportionally to the fronts brakes. This pressure reduction is achieved by controlling the rear isolation valves in conjunction with the pressure reducing valve, which both controlled proportionally. Feedback from a pressure transducer (regenerative axle pressure) is used for this control. The boost valve itself controls the pressure applied to the front wheel brakes during regenerative brake blending.

Accumulator and Pump Motor Operations

The accumulator is charged independently of the brakes being applied, meaning that the motor may run at any time when the vehicle is powered. The pressure transducer (High Pressure Accumulator) is used by the EBCM to determine when the accumulator pressure is low. The EBCM controls the motor such that it runs from the time when the accumulator pressure is seen to be low until the high pressure accumulator is fully charged. A dual pump arrangement is used and is driven by an electronically commutator motor.

EBCM Controls

The EBCM controls the current to the boost valve so that pressure can be applied to the wheel brakes. The boost valve is a spool type valve which is referenced to the controlled pressure so that for a given current applied, a specific pressure is expected. The boost valve controls the pressure apply from the accumulator through the rear isolation valves directly to the rear wheel brakes, and through the front isolation valves, to the individual front pressure chambers behind the secondary pistons in the master cylinder, which in turn apply pressure to the front wheel brakes.

Base Brake Valves (Normal Open)

The normally open base brake valve is used to keep boost pressure from feeding back to the master cylinder which would increase the force back to the pedal. It closes off a passage which is used to apply pressure to the wheel brakes from the master cylinder in the case of a system failure. In this case the system failure referred to is one which results in a control mode known as push through. In normal operation the normally open base brake valve is on (closed) during a boost pressure apply event, and is left off (open) during failed system operation.

Base Brake Valves (Normal Closed)

The normally closed base brake valve is used to close off a passage which allows fluid from the back side (spring side) of the simulator and from the tank port of the boost valve to exit to the reservoir. In normal

braking, turning this valve on (opening) allows the simulator to compress the spring and function normally. During failed system operation (push-through) the valve is left off (closed) keeping fluid from exiting the back side of the simulator, which in turn keeps master cylinder fluid from entering the front side of the simulator. In this way, fluid from the master cylinder during failed system, and push through operation is applied only to the wheel brakes, and not lost in the simulator. In normal operation the valve is turned on (opened).

Vehicle Stability Control

Stability control provides added stability during aggressive maneuvers. Yaw rate is the rate of rotation about the vehicle's vertical axis. The stability control is activated when the EBCM determines that the desired yaw rate does not match the actual yaw rate as measured by the yaw rate sensor.

The desired yaw rate is calculated by the EBCM using the following inputs:

- Steering wheel position
- Vehicle speed
- Lateral acceleration

The difference between the desired yaw rate and the actual yaw rate is the yaw rate error, which is a measurement of oversteer or understeer. When a yaw rate error is detected, the EBCM attempts to correct the vehicle's yaw motion by applying brake pressure to one or more of the wheels. The amount of applied brake pressure varies, depending on the correction required.

Power-up Self-Test

The EBCM is able to detect many malfunctions whenever the ignition is ON. However, certain failures cannot be detected unless active diagnostic tests are performed on the components. Shorted solenoid coil or motor windings, for example, cannot be detected until the components are commanded ON by the EBCM. Therefore, a power-up self-test is required at the beginning of each ignition cycle to verify correct operation of components before the various control systems can be enabled. The EBCM performs the power-up self-test when the ignition is first turned ON. The system relay, solenoids and the ABS pump motor are commanded ON and OFF to verify proper operation and the EBCM verifies the ability to return the system to base braking in the event of a failure.

United Nations Economic Commission for Europe Regulation Number 13 (ECE 13) Response

The EBCM illuminates the ABS indicator when a malfunction which disables ABS is detected. Usually, the ABS indicator is turned OFF during the following ignition cycle unless the fault is detected during that ignition cycle. However, the setting of a wheel speed sensor related DTC may cause the ABS indicator to remain illuminated during the following ignition cycle until the vehicle is operated at a speed greater than 13 km/h (8 MPH) or, occasionally, 64 km/h (40 MPH), depending on which DTC sets. This allows the EBCM to verify that no malfunction exists, before turning OFF the ABS indicator. It is important to verify that United Nations Economic Commission for Europe regulation number 13 (ECE 13) is not the cause of an ABS indicator which is illuminated when no DTCs are set, before attempting to diagnose other possible causes.

Driver Information Indicators

The following indicators are used to inform the driver of several different factors.

Brake Warning Indicator

The instrument cluster illuminates the brake warning indicator when the following occurs.

- The instrument cluster performs the bulb check.
- The EBCM detects an ABS malfunction which also disables electronic brake distribution and sends a serial data message to the instrument cluster requesting illumination.
- The body control module (BCM) detects a low brake fluid condition or a base brake pressure differential and sends a serial data message to the instrument cluster requesting illumination.
- The BCM detects that the park brake is engaged. The instrument panel cluster receives a serial data message from the BCM requesting illumination. The brake warning indicator flashes at a rate of approximately twice per second when the park brake is engaged.

ABS Indicator

The instrument cluster illuminates the ABS indicator when the following occurs:

- The instrument cluster performs the bulb check.
- The instrument cluster detects a loss of serial data communication with the EBCM.
- The EBCM detects an ABS malfunction and sends a serial data message to the instrument cluster requesting illumination.
- A DTC is set during the previous ignition cycle which requires a United Nations Economic Commission for Europe regulation number 13 (ECE 13) response at the beginning of the current ignition cycle. The EBCM sends a serial data message to the instrument cluster requesting illumination.

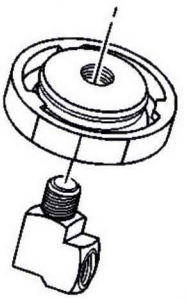
Traction Control/Stability Control Indicator

The instrument cluster turns the traction control/stability control indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The instrument cluster detects a loss of serial data communication with the EBCM.
- The EBCM detects an ABS malfunction and sends a serial data message to the instrument cluster requesting illumination.
- A DTC is set during the previous ignition cycle which requires a United Nations Economic Commission for Europe regulation number 13 (ECE 13) response at the beginning of the current ignition cycle. The EBCM sends a serial data message to the instrument cluster requesting illumination.

Special Tools and Equipment

Illustration	Tool Number/ Description
2076273	CH 29532-A J 29532-A Pressure Brake Bleeder

Illustration	Tool Number/ Description
 741224	CH 44894-A J 44894-A Brake Pressure Bleeder Adapter

Disc Brakes

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Brake Caliper Bleeder	10 N•m	89 lb in
Brake Caliper Bracket Bolt - Front	95 N•m	70 lb ft
Brake Caliper Bracket Bolt - Rear	56 N•m	41 lb ft
Brake Caliper Guide Pin Bolt - Front and Rear	28 N•m	21 lb ft
Brake Hose Fitting Bolt - Front and Rear	40 N•m	30 lb ft
Brake Rotor Bolt - Front and Rear	4 N•m	35 lb in
Brake Shield Bolt	4 N•m	35 lb in

Disc Brake Component Specifications

Application	Specification	
	Metric	English
Front Brakes		
Brake Pad Lining Thickness - Minimum	2.0 mm	0.079 in
Brake Pad Lining Thickness - New	11.0 mm	0.433 in
Brake Rotor Diameter	256.0 mm	10.079 in
Brake Rotor Discard Thickness	21.0 mm	0.827 in
Brake Rotor Maximum Allowable Assembled Lateral Runout	0.05 mm	0.002 in
Brake Rotor Maximum Allowable Scoring	1.50 mm	0.059 in
Brake Rotor Maximum Allowable Thickness Variation	0.02 mm	0.0008 in
Brake Rotor Minimum Allowable Thickness After Refinish	22.0 mm	0.866 in
Brake Rotor Thickness - New	24.0 mm	0.945 in
Rear Brakes		
Brake Pad Lining Thickness - Minimum	2.0 mm	0.079 in
Brake Pad Lining Thickness - New	9.0 mm	0.354 in
Brake Rotor Diameter	258.0 mm	10.158 in
Brake Rotor Discard Thickness	8.8 mm	0.346 in
Brake Rotor Maximum Allowable Assembled Lateral Runout	0.05 mm	0.002 in
Brake Rotor Maximum Allowable Scoring	1.50 mm	0.059 in
Brake Rotor Maximum Allowable Thickness Variation	0.02 mm	0.0008 in
Brake Rotor Minimum Allowable Thickness After Refinish	9.0 mm	0.354 in
Brake Rotor Thickness - New	10.4 mm	0.409 in

Adhesives, Fluids, Lubricants, and Sealers

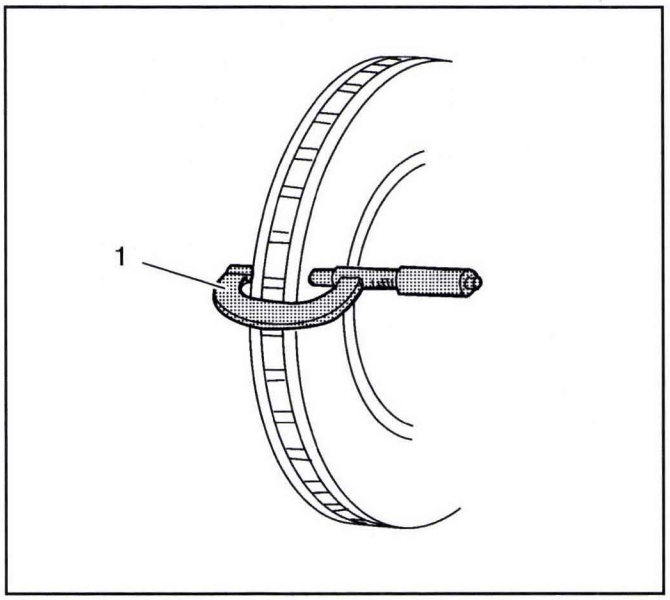
Application	Type of Material	GM Part Number
Hydraulic Brake System	DOT 4 Motor Vehicle Brake Fluid	19299570 (Canada 19299571)

Diagnostic Information and Procedures

Brake Rotor Thickness Measurement

Warning: Refer to Brake Dust Warning on page 0-4.

1. If the inboard friction surface of the brake rotor is not accessible, reposition and support the caliper with the brake pads. Refer to *Front Disc Brake Pads Replacement on page 5-103* and/or *Rear Disc Brake Pads Replacement on page 5-105*.
2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.



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3. Using a micrometer (1) calibrated in thousanths-of-a-millimeter, or ten-thousanths-of-an-inch, measure and record the thickness of the brake rotor at four or more points, evenly spaced around the rotor.

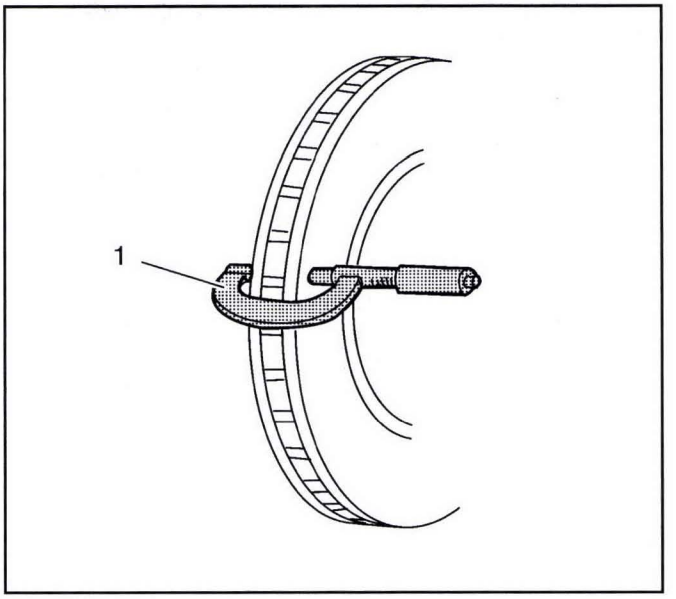
   Ensure that the measurements are only taken within the friction surfaces and that the micrometer is positioned the same distance from the outer edge of the rotor, about 13 mm (½ in), for each measurement.
4. Compare the lowest thickness measurement recorded specifications. Refer to *Disc Brake Component Specifications on page 5-96*.
5. If the lowest thickness measurement of the brake rotor is above the minimum allowable thickness after refinishing specification, the rotor may be able to be refinished, depending upon surface and wear conditions which may be present.
6. If the lowest thickness measurement of the brake rotor is at or below the minimum allowable thickness after refinishing specification, the rotor may not be refinished.
7. If the lowest thickness measurement of the brake rotor is at or below the discard thickness specification, the rotor requires replacement.

Brake Rotor Thickness Variation Measurement

Warning: Refer to Brake Dust Warning on page 0-4.

Note: Any disc brake rotor that exhibits thickness variation exceeding the maximum acceptable level must be refinished or replaced. Thickness variation exceeding the maximum acceptable level can cause brake pulsation.

1. If the inboard friction surface of the brake rotor is not accessible, reposition and support the caliper with the brake pads. Refer to *Front Disc Brake Pads Replacement on page 5-103* and/or *Rear Disc Brake Pads Replacement on page 5-105*.
2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.



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3. Using a micrometer (1) calibrated in thousandths-of-a-millimeter, or ten-thousandths-of-an-inch, measure and record the thickness of the brake rotor at 4 or more points, evenly spaced around the rotor.

   Ensure that the measurements are only taken within the friction surfaces and that the micrometer is positioned the same distance from the outer edge of the rotor, about 13 mm (½ in), for each measurement.
4. Calculate the difference between the highest and lowest thickness measurements recorded to obtain the amount of thickness variation.
5. Compare the thickness variation measurement to the following specification:

   Specification

   Brake rotor maximum allowable thickness variation: 0.025 mm (0.001 in)

Note: Whenever a brake rotor is refinished or replaced, the assembled lateral runout (LRO) of the rotor must be measured to ensure optimum performance of the disc brakes.

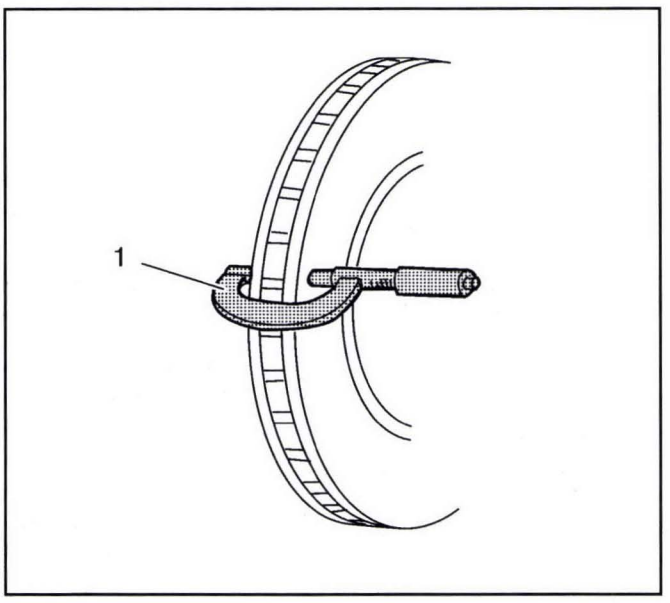
6. If the brake rotor thickness variation measurement exceeds the specification, the rotor requires refinishing or replacement.

Brake Rotor Surface and Wear Inspection

Warning: Refer to Brake Dust Warning on page 0-4.

1. If the inboard friction surface of the brake rotor is not accessible, reposition and support the caliper with the brake pads. Refer to *Front Disc Brake Pads Replacement on page 5-103* and/or *Rear Disc Brake Pads Replacement on page 5-105*.
2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.
3. Inspect the friction surfaces of the brake rotor for the following Braking Surface Conditions:
   - Heavy rust and/or pitting

     Light surface rust can be removed with an abrasive disc. Heavy surface rust and/or pitting must be removed by refinishing the rotor.
   - Cracks and/or heat spots
   - Excessive blueing discoloration
4. If the friction surfaces of the brake rotor exhibit one or more of the Braking Surface Conditions, the rotor requires refinishing or replacement.



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5. Using a micrometer (1) calibrated in thousandths-of-a-millimeter, or ten-thousandths-of-an-inch, measure and record the scoring depth of any grooves present on the rotor friction surfaces.
6. Compare the groove scoring depth recorded to the following specification:

   Specification

   Brake rotor maximum allowable scoring: 1.50 mm (0.059 in)
7. If the brake rotor scoring depth exceeds the specification, or if an excessive amount of scoring is present, the rotor requires refinishing or replacement.

Brake Rotor Assembled Lateral Runout Measurement

Special Tools

- *CH-41013* Rotor Resurfacing Kit
- *CH-42450-A* Wheel Hub Resurfacing Kit
- *CH-45101* Hub and Wheel Runout Gauge
- *CH-45101-100* Conical Brake Rotor Washers

For equivalent regional tools, refer to *Special Tools on page 5-132*.

Warning: Refer to Brake Dust Warning on page 0-4.

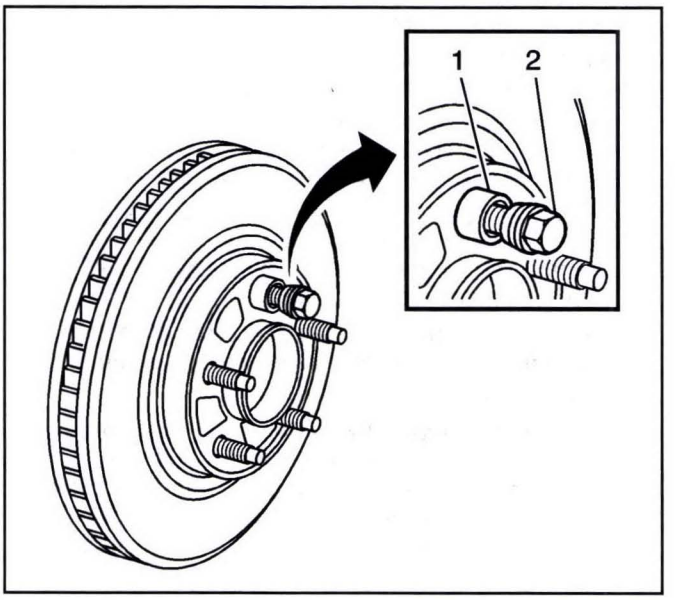
Note:

- Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4,800–11,300 km (3,000–7,000 mi).
- Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to *Brake Rotor Thickness Variation Measurement on page 5-97*.

1. Matchmark the position of the brake rotor to the wheel studs if this has not been done already.

   Note: Whenever the brake rotor has been separated from the hub/axle flange, any rust or contaminants should be cleaned from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in excessive assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.
2. Inspect the mating surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles, corrosion, rust, or debris remaining. If the wheel hub/axle flange and/or if the brake rotor mating surfaces exhibit these conditions, perform the following steps:
   2.1. Remove the brake rotor from the vehicle. Refer to *Front Brake Rotor Replacement on page 5-122* and/or *Rear Brake Rotor Replacement on page 5-124*.
   2.2. Using the *CH-42450-A* wheel hub resurfacing kit, thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange.
   2.3. Using the *CH-41013* rotor resurfacing kit, thoroughly clean any rust or corrosion from the mating surface of the brake rotor.
   2.4. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.

3. Install the rotor to the hub/axle flange using the matchmark made prior to removal.



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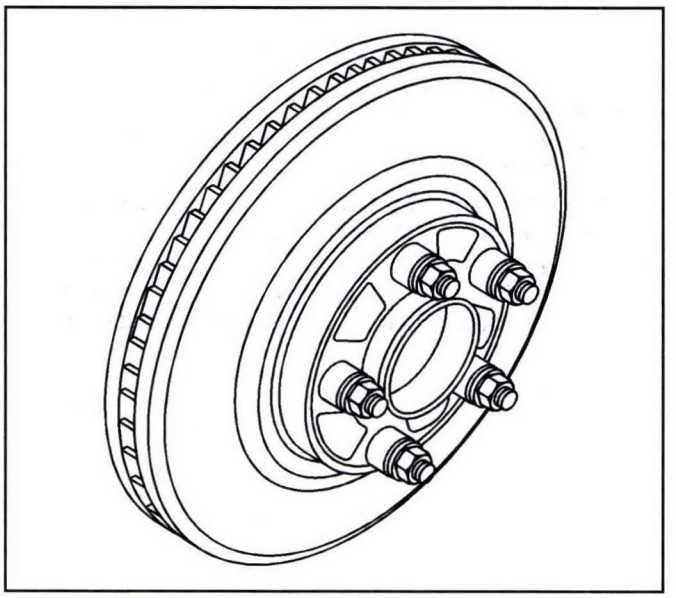
4. Hold the rotor firmly in place against the hub/axle flange and install one of th *CH-45101-100* conical brake rotor washers (1), and one lug nut (2) onto the upper-most wheel stud.
5. Continue to hold the rotor secure and tighten the lug nut firmly by hand.



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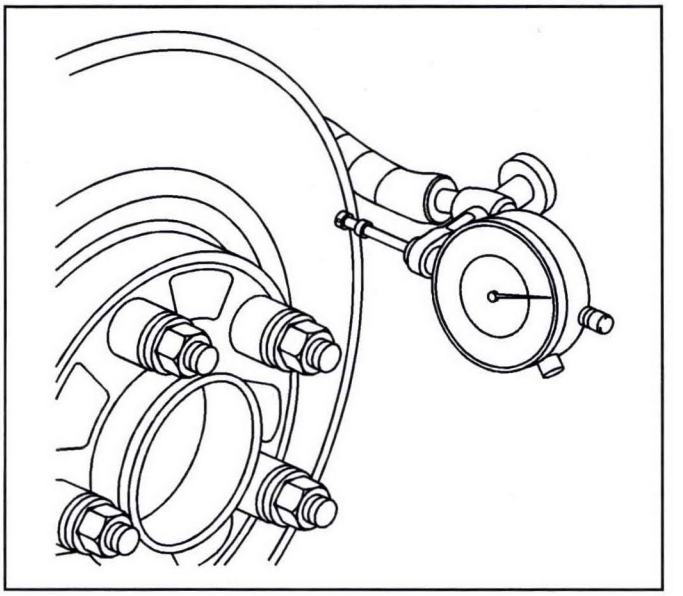
6. Install the remaining *CH-45101-100* conical brake rotor washers and lug nuts onto the wheel studs and tighten the nuts firmly by hand in a star-pattern.
7. Tighten the lug nuts in a star-pattern to specification. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
8. If the brake rotor has been REFINISHED or REPLACED with a new rotor, proceed to step 14.
9. If the brake rotor meets the following criteria, proceed to step 10.
   - The rotor is within specifications and is being REUSED.
   - The rotor has NOT been refinished.
   - The rotor does NOT exhibit thickness variation exceeding the maximum allowable level.



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10. Mount a dial indicator, *CH-45101* hub and wheel runout gauge, or equivalent, to the steering knuckle and position the indicator button so it contacts the brake rotor friction surface at a 90 degree angle, approximately 13 mm (0.5 in) from the outer edge of the rotor.
11. Measure and record the assembled LRO of the brake rotor.
    11.1. Rotate the rotor until the lowest reading is displayed on the indicator dial, then set the dial to zero.
    11.2. Rotate the rotor until the highest reading is displayed on the dial.
    11.3. Mark the location of the high spot relative to the nearest wheel stud, or studs.
    11.4. Measure and record the amount of LRO.
12. Compare the brake rotor assembled LRO to the following specification:

    Specification

    - Front brake rotor maximum allowable assembled lateral runout: 0.05 mm (0.002 in)
    - Rear brake rotor maximum allowable assembled lateral runout: 0.05 mm (0.002 in)
13. If the brake rotor assembled LRO is within specifications, proceed to step 18.

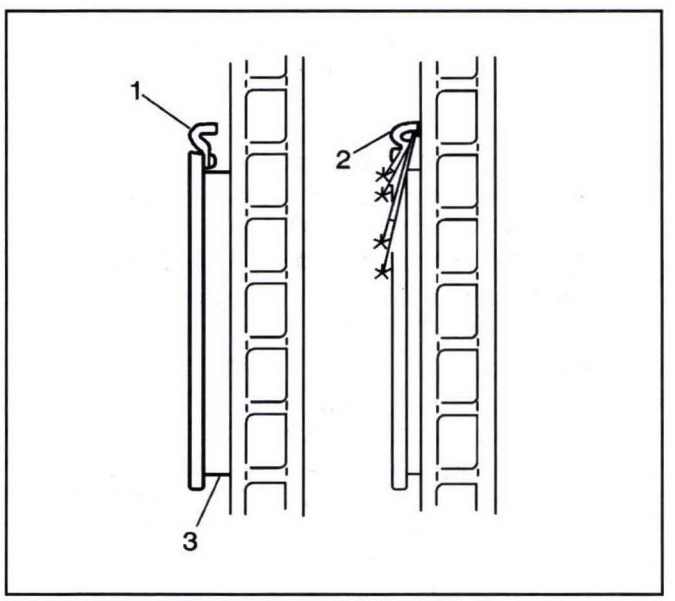
    If the brake rotor assembled LRO exceeds the specification, refinish the rotor to ensure true parallelism. Refer to *Brake Rotor Refinishing on page 5-130*. After refinishing the rotor, proceed to step 14.

14. Mount a dial indicator, *CH-45101* hub and wheel runout gauge, or equivalent, to the steering knuckle and position the indicator button so it contacts the brake rotor friction surface at a 90 degree angle, approximately 13 mm (0.5 in) from the outer edge of the rotor.
15. Measure and record the assembled LRO of the brake rotor.
    15.1. Rotate the rotor until the lowest reading is displayed on the indicator dial, then set the dial to zero.
    15.2. Rotate the rotor until the highest reading is displayed on the dial.
    15.3. Mark the location of the high spot relative to the nearest wheel stud, or studs.
    15.4. Measure and record the amount of LRO.
16. Compare the brake rotor assembled LRO to the following specification:

    Specification

    - Front brake rotor maximum allowable assembled lateral runout: 0.05 mm (0.002 in)
    - Rear brake rotor maximum allowable assembled lateral runout: 0.05 mm (0.002 in)
17. If the brake rotor assembled LRO measurement exceeds the specification, bring the LRO to within specifications. Refer to *Brake Rotor Assembled Lateral Runout Correction on page 5-126*.
18. If the brake rotor assembled LRO measurement is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the *CH-45101-100* conical brake rotor washers and the lug nuts.

Brake Pad Inspection



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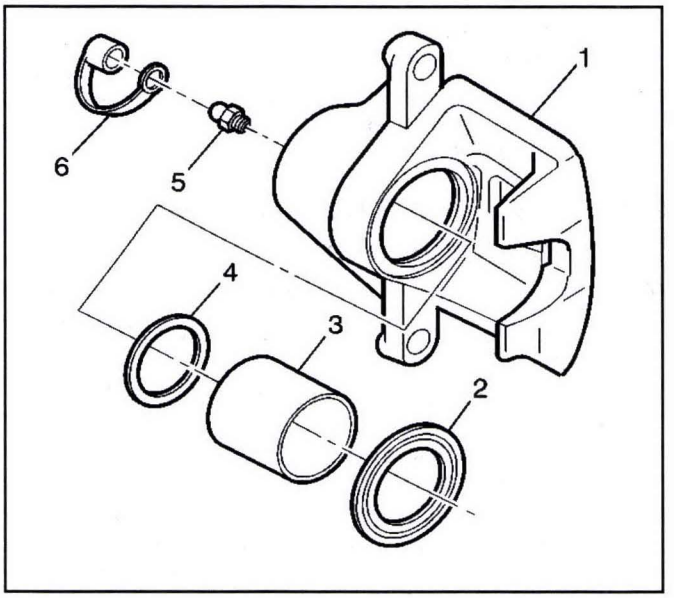
Warning: Refer to Brake Dust Warning on page 0-4.

1. Inspect the disc brake pads at regular intervals, or whenever the tire and wheel assemblies are removed from the vehicle.
2. If replacement is necessary, always replace disc brake pads in axle sets.
3. Inspect both edges of the disc brake pad friction surfaces (3). The highest rate of wear normally occurs at the trailing edge of the disc brake pads.
4. Inspect the thickness of the disc brake pads (3) in order to ensure that they have not worn prematurely. The disc brake pad wear should be approximately even per axle set.

   Note: When replacing the disc brake pads, maintain the same disc brake pad wear sensor orientation.
5. Both front and rear disc brake pads have integral, audible wear sensors (1). When the disc brake pad wear reaches the minimum allowable thickness, the wear sensor contacts the disc brake rotor (2). The wear indicator will then produce an audible, high-pitched warning noise during wheel rotation.
6. Replace the disc brake pads when the friction surface (3) is worn to within 0.76 mm (0.030 in) of the mounting plates.
7. Remove the brake calipers and inspect the friction surfaces of the inner and outer disc brake pads to ensure that they are level. Place the disc brake pad friction surfaces together and measure the gap between the surfaces. If more than 0.13 mm (0.005 in) gap exists midway between the length of the disc brake pads, replace the disc brake pads.
8. Verify that any disc brake pad shims that may be required are in place and not damaged or excessively corroded. Replace any missing or damaged shims in order to preserve proper disc brake performance.
9. Replace the disc brake pads if any have separated from the mounting plates.
10. Inspect the disc brake pads friction surfaces for cracks, fractures, or damage which may cause noise or otherwise impair disc brake performance.

Brake Caliper Inspection



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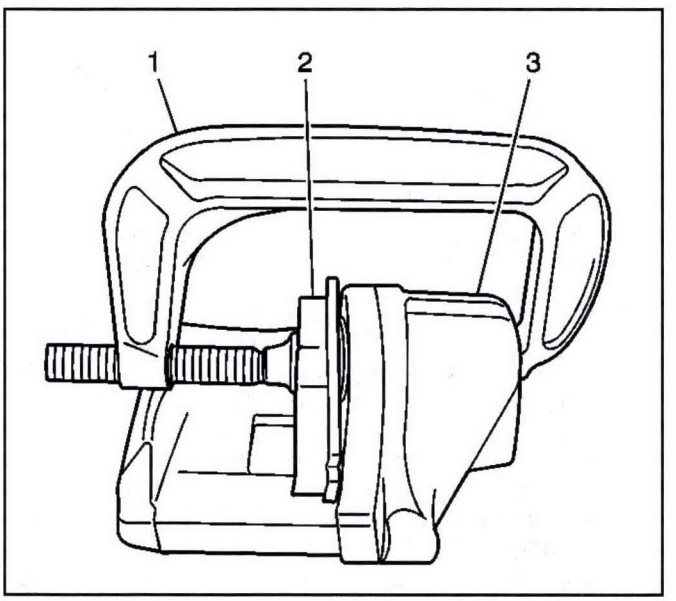
Warning: Refer to Brake Dust Warning on page 0-4.

1. Inspect the brake caliper housing (1) for cracks, excess wear, and/or damage. If any of these conditions are present, the brake caliper requires replacement.
2. Inspect the caliper piston dust boot seal (2) for cracks, tears, cuts, deterioration and/or improper seating in the caliper body. If any of these conditions are present, the brake caliper requires overhaul or replacement.
3. Inspect for brake fluid leakage around the caliper piston dust boot seal (2) and on the disc brake pads. If there is any evidence of brake fluid leakage, the brake caliper requires overhaul or replacement.



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4. Inspect for smooth and complete travel of the caliper pistons into the caliper bores:

   The movement of the caliper pistons into the caliper bores should be smooth and even. If the caliper piston is frozen or difficult to bottom, the caliper requires overhaul or replacement.

   - For single piston caliper applications, insert a discarded inner brake pad (2) or block of wood in front of the piston. Using a large C-clamp (1) installed over the body of the caliper (3) and against the brake pad or block of wood, slowly bottom the piston in the bore.
   - For dual piston caliper applications, insert a discarded inner brake pad (2) or block of wood in front of the pistons. Using 2 large C-clamps (1) installed over the body of the caliper (3) and against the brake pad or block of wood, slowly bottom the pistons evenly into the bores.

Front Disc Brake Mounting and Hardware Inspection

Warning: Refer to Brake Dust Warning on page 0-4.

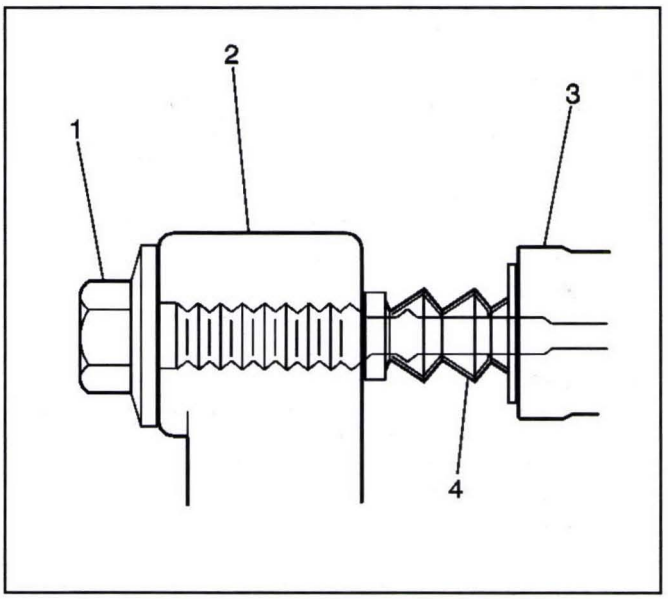
1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum–full point and the minimum allowable level then no brake fluid needs to be removed from the reservoir before proceeding.
3. If the brake fluid level is higher than midway between the maximum–full point and the minimum allowable level then remove brake fluid to the midway point before proceeding.

Danger: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

4. Raise and support the vehicle. Refer *Lifting and Jacking the Vehicle on page 1-27*.
5. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
6. Grasp the brake caliper housing and try to move the brake caliper housing up/down and forward/reverse in relation to the brake caliper mounting bracket. If excessive looseness is observed the brake caliper bracket bushings and/or the brake caliper mounting bolts may need to be replaced.
7. Compress the front caliper pistons.
   - Install a large C-clamp over the top of the caliper housing and against the back of the outboard pad.
   - Slowly tighten the C-clamp until the pistons are pushed completely into the caliper bores.
   - Remove the C-clamp from the caliper.
8. With the pistons compressed into the caliper bores, grasp the brake caliper housing and slide it back and forth on the brake caliper mounting bolts. Check for smooth operation. If the brake caliper housing slide force is high or the brake caliper housing does not slide smoothly, inspect the brake caliper mounting bolts and/or the brake caliper mounting bracket bushings for wear or damage.

If wear or damage conditions are found, replacement of the brake caliper mounting bolts and/or the brake caliper mounting bracket bushings is necessary.

9. Remove the brake caliper mounting bolts from the brake caliper mounting bracket and support the brake caliper using heavy mechanics wire. Do Not remove the hydraulic brake hose from the caliper. Refer to *Front Brake Caliper Replacement on page 5-108*.
10. Remove the disc brake pads from the brake caliper mounting bracket.
11. Inspect the disc brake pad mounting hardware for the following:
    - Missing mounting hardware
    - Excessive corrosion
    - Bent mounting tabs
    - Looseness at the brake caliper mounting bracket
    - Looseness at the disc brake pads
    - Excessive contaminants in the brake caliper mounting bracket surface and threads.
12. If any of the conditions listed are found, the disc brake pad mounting hardware requires replacement.
13. Ensure the disc brake pads are held firmly in place on the brake caliper mounting bracket, yet slide easily on the mounting hardware without binding.



344219

14. Inspect the caliper bolts (1) for the following:
    - Binding
    - Seizing
    - Looseness in the brake caliper mounting bracket (3)
    - Bent or damaged brake caliper mounting bolts
    - Cracked or torn boots (4)
    - Missing boots
    - Bent or damaged brake caliper mounting bracket (3)
15. If any of the conditions listed are found then the brake caliper mounting hardware requires replacement.
16. Install the disc brake pads to the brake caliper mounting bracket.
17. Install the disc brake caliper to the brake caliper mounting bracket. Refer to *Front Brake Caliper Replacement on page 5-108*.

Rear Disc Brake Mounting and Hardware Inspection

Warning: Refer to Brake Dust Warning on page 0-4.

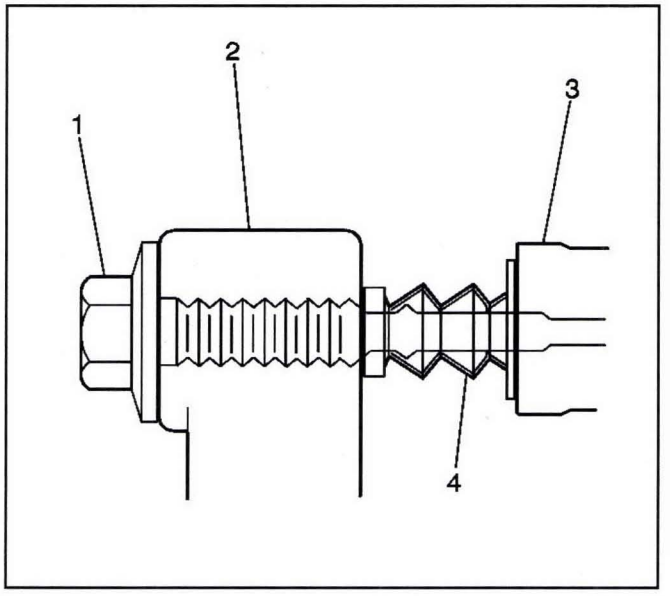
1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum–full point and the minimum allowable level then no brake fluid needs to be removed from the reservoir before proceeding.
3. If the brake fluid level is higher than midway between the maximum–full point and the minimum allowable level then remove brake fluid to the midway point before proceeding.

Danger: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

4. Raise and support the vehicle. Refer *Lifting and Jacking the Vehicle on page 1-27*.
5. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
6. Grasp the brake caliper housing and try to move the brake caliper housing up/down and forward/reverse in relation to the brake caliper mounting bracket. If excessive looseness is observed the brake caliper bracket bushings and/or the brake caliper mounting bolts may need to be replaced.
7. Compress the rear caliper piston.
    - Install a large C-clamp over the top of the caliper housing and against the back of the outboard pad.
    - Slowly tighten the C-clamp until the piston is pushed completely into the caliper bores.
    - Remove the C-clamp from the caliper.
8. With the piston compressed into the caliper bore, grasp the brake caliper housing and slide it back and forth on the brake caliper mounting bolts. Check for smooth operation. If the brake caliper housing slide force is high or the brake caliper housing does not slide smoothly, inspect the brake caliper mounting bolts and/or the brake caliper mounting bracket bushings for wear or damage. If wear or damage conditions are found, replacement of the brake caliper mounting bolts and/or the brake caliper mounting bracket bushings is necessary.
9. Remove the brake caliper mounting bolts from the brake caliper mounting bracket and support the brake caliper using heavy mechanics wire. Do not

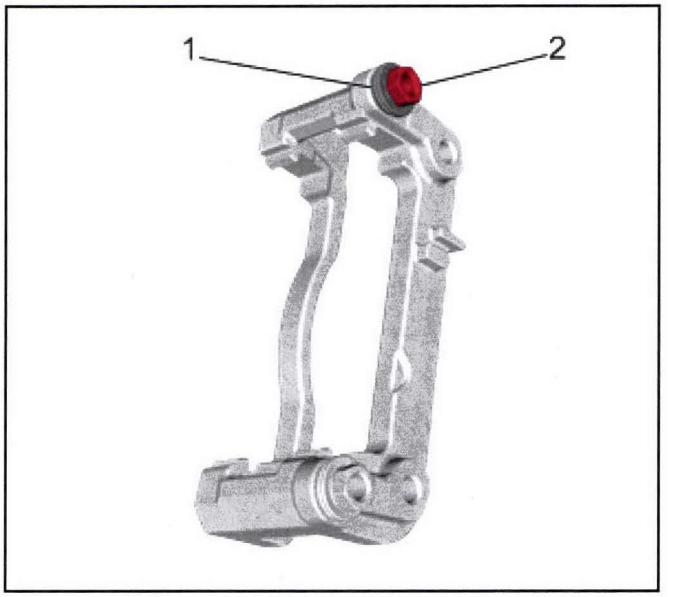
disconnect the hydraulic brake hose from the caliper. Refer to *Rear Brake Caliper Replacement on page 5-109*.

10. Remove the disc brake pads from the brake caliper mounting bracket.
11. Inspect the disc brake pad mounting hardware for the following:
    - Missing mounting hardware
    - Excessive corrosion
    - Bent mounting tabs
    - Looseness at the brake caliper mounting bracket
    - Looseness at the disc brake pads
    - Excessive contaminants in the brake caliper mounting bracket surface and threads.
12. If any of the conditions listed are found, the disc brake pad mounting hardware requires replacement.
13. Ensure the disc brake pads are held firmly in place on the brake caliper mounting bracket, yet slide easily on the mounting hardware without binding.



344219

14. Inspect the caliper bolts (1) or guide pins for the following:
    - Binding
    - Seizing
    - Looseness in the brake caliper mounting bracket (3)
    - Bent or damaged brake caliper mounting bolts or guide pins
    - Cracked or torn boots (4)
    - Missing boots
    - Bent or damaged brake caliper mounting bracket (3)
15. If any of the conditions listed are found then the brake caliper mounting hardware requires replacement.
16. Install the disc brake pads to the brake caliper mounting bracket.



3980461

Note: Excess brake lubricant and trapped air must be expelled from the brake caliper guide pin bore to allow full caliper movement and prevent premature brake pad wear.

17. Gently pull the edge of the upper guide pin seal (1) away from the brake caliper guide pin (2) while simultaneously pushing the brake caliper guide pin into the brake caliper bracket to expel any trapped air and excess brake lubricant.
18. Repeat step 17 for the lower guide pin seal and brake caliper guide pin.
19. With a clean shop towel, clean any excess brake lubricant from the guide pin seal and brake caliper guide pin.
20. Install the disc brake caliper to the brake caliper mounting bracket. Refer to *Rear Brake Caliper Replacement on page 5-109*.

Repair Instructions

Front Disc Brake Pads Replacement

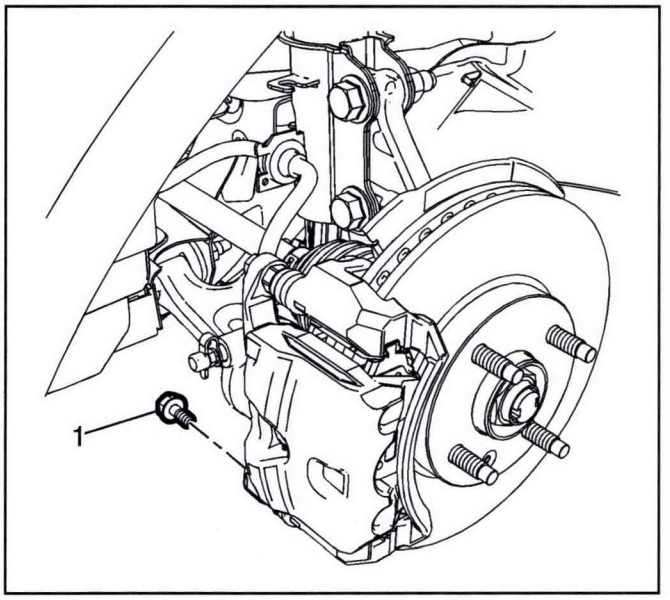
Removal Procedure

Warning: Refer to Brake Dust Warning on page 0-4.

Note: Always replace disc brake pads in axle sets.

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum-full point and the minimum allowable level, no brake fluid needs to be removed before proceeding.
3. If the brake fluid level is higher than midway between the maximum-full point and the minimum allowable level, remove brake fluid to the midway point before proceeding.
4. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
5. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.

6. Place a large C-clamp over the brake caliper body and against the outer brake pad.
7. Using the C-clamp, compress the brake caliper piston fully into the brake caliper bore.



2537412

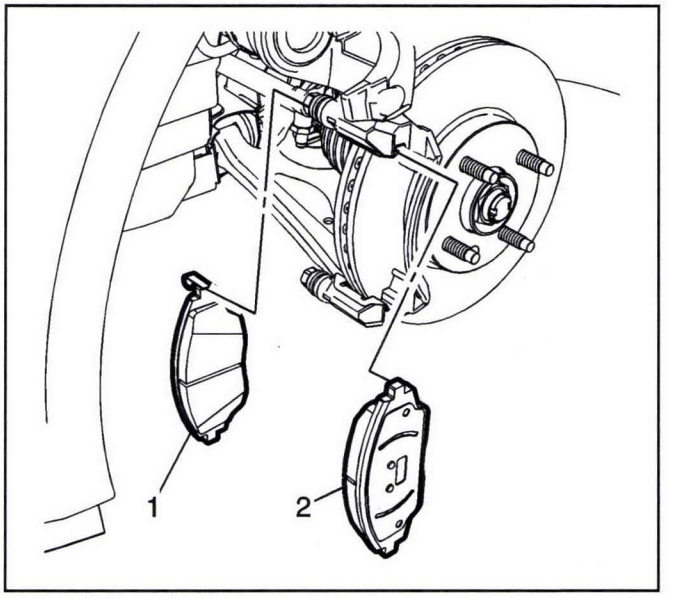
Note:

- DO NOT use any air tools to remove or install the guide pin bolts. Use hand tools ONLY.
- Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt. DO NOT allow the open end wrench to come in contact with the brake caliper. Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.

8. Using a backup wrench to hold the brake caliper guide pin stationary, remove the lower brake caliper guide pin bolt (1).

Caution: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

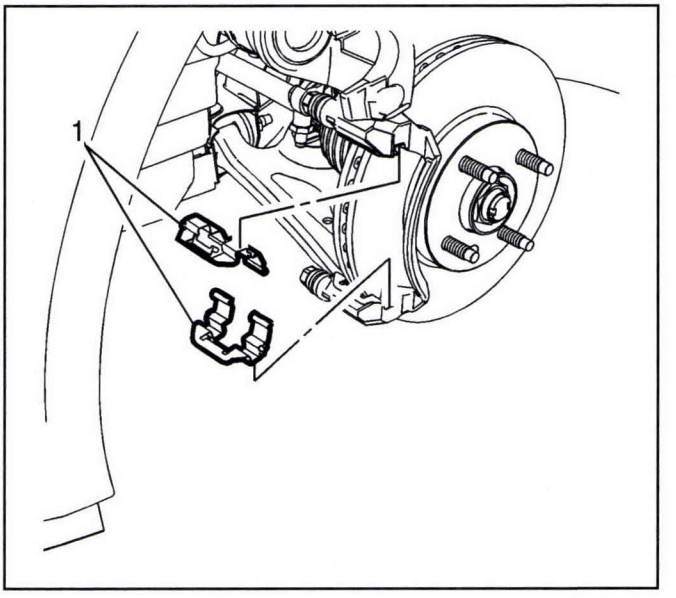
9. Rotate the brake caliper upward and support with heavy mechanics wire.



2537414

Note: Note the location of the brake pad wear sensor for correct installation.

10. Remove the inner brake pad (1).
11. Remove the outer brake pad (2).

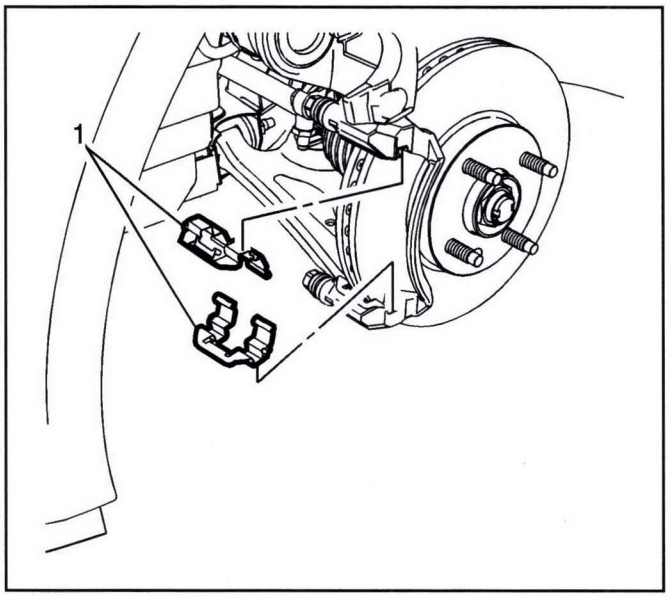


2537415

12. Remove the upper and lower brake pad springs (1).
13. If installing new brake pads, discard the brake pad springs.

Installation Procedure

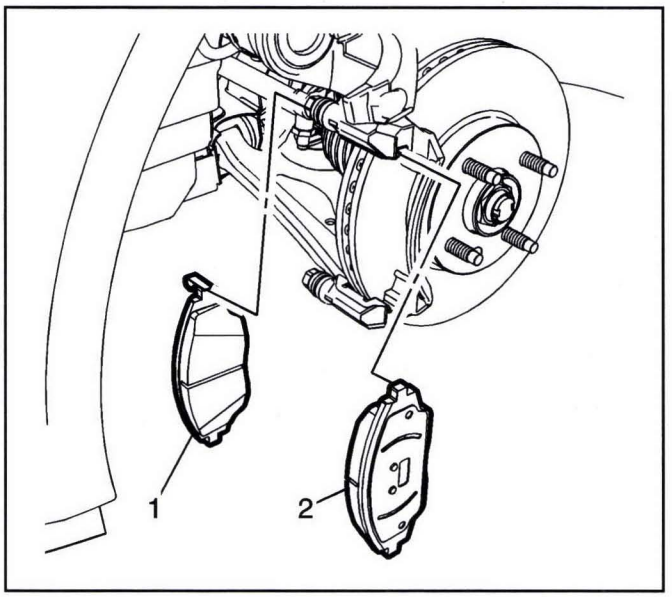
1. Thoroughly clean the contact surfaces of the brake caliper bracket of any corrosion or debris.



2537415

Note: If installing new brake pads, install new brake pad springs.

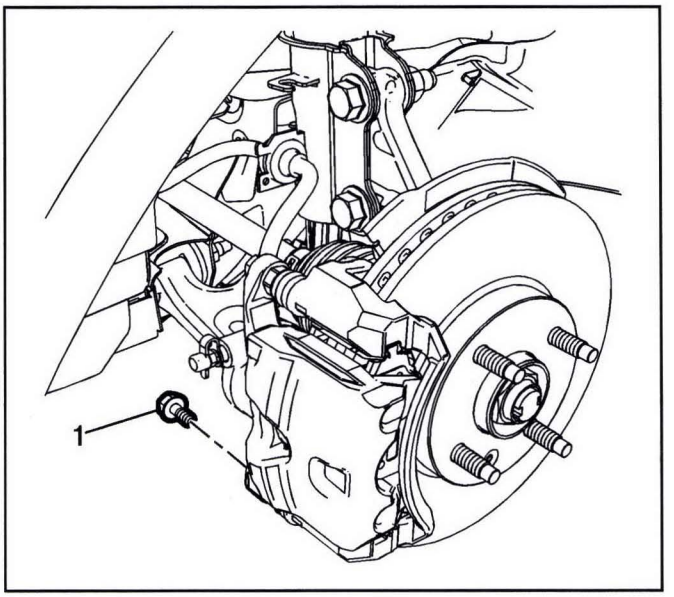
2. Install the upper and lower brake pad springs (1).



2537414

Note: Note the location of the brake pad wear sensor for correct installation.

3. Install the inner brake pad (1).
4. Install the outer brake pad (2).
5. Position the brake caliper over the brake pads and to the caliper bracket.



2537412

Caution: Refer to *Fastener Caution on page 0-8*.

6. Using a backup wrench to hold the brake caliper guide pin stationary, install the lower brake caliper guide pin bolt (1) and tighten to **28 N•m (21 lb ft)**.
7. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
8. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
9. Slowly release the brake pedal.
10. Wait 15 seconds, then repeat steps 8 and 9 until the brake pedal remains high and firm. This will properly seat the brake caliper pistons and brake pads.
11. Fill the master cylinder reservoir. Refer to *Master Cylinder Reservoir Filling on page 5-165*.
12. Burnish the brake pads and rotors. Refer to *Brake Pad and Rotor Burnishing on page 5-108*.

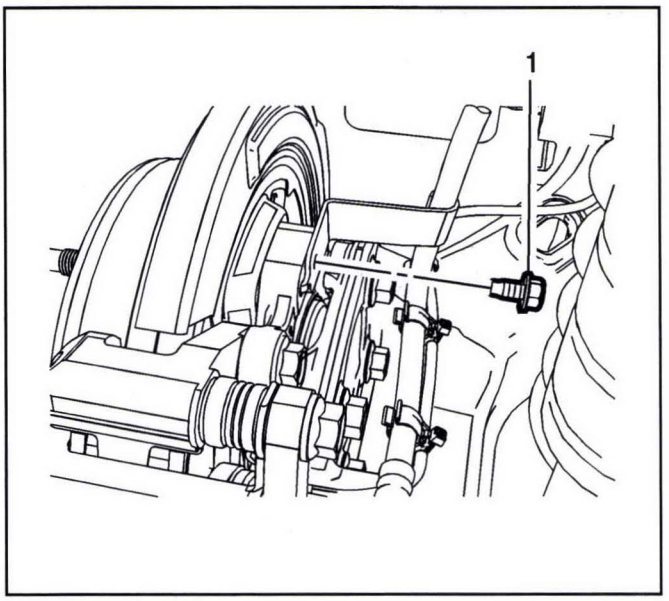
Rear Disc Brake Pads Replacement

Removal Procedure

Warning: Refer to Brake Dust Warning on page 0-4.

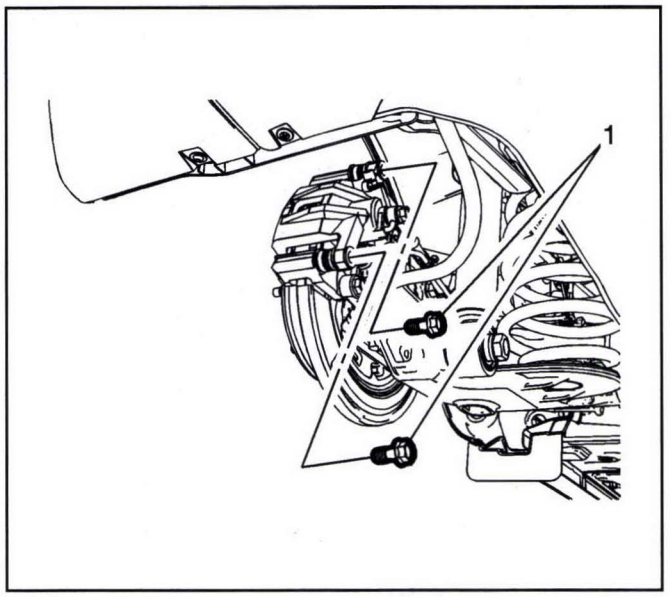
Note: Always replace disc brake pads in axle sets.

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum-full point and the minimum allowable level, no brake fluid needs to be removed before proceeding.
3. If the brake fluid level is higher than midway between the maximum-full point and the minimum allowable level, remove brake fluid to the midway point before proceeding.
4. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
5. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.



3227991

6. Remove the brake hose bracket bolt (1).



3034091

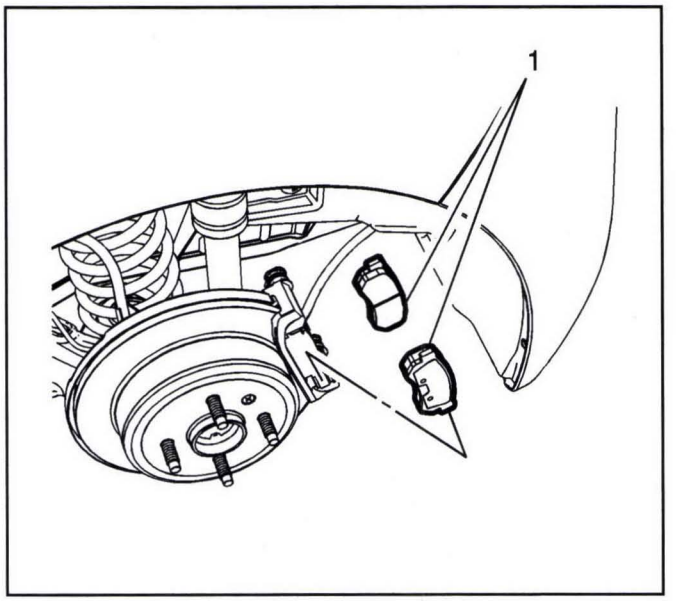
Note:

- DO NOT use any air tools to remove or install the guide pin bolts. Use hand tools ONLY.
- Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt. DO NOT allow the open end wrench to come in contact with the brake caliper. Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.

7. Using a backup wrench to hold the brake caliper guide pins stationary, remove the brake caliper guide pin bolts (1).

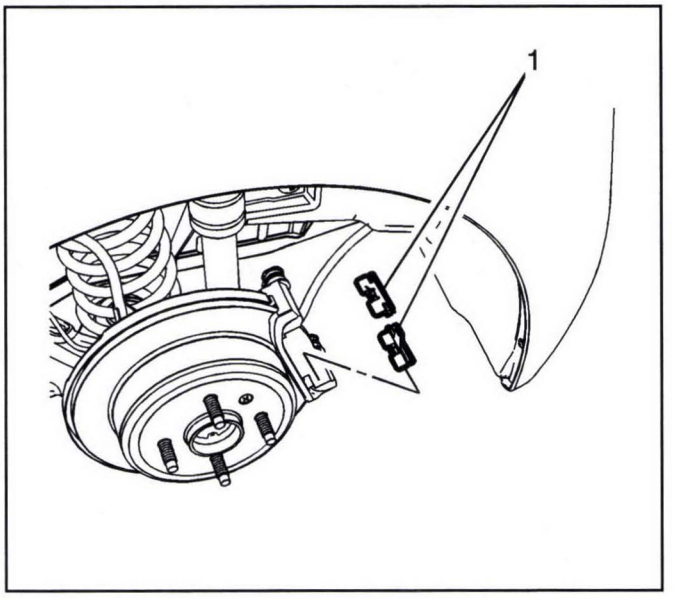
Caution: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

8. Remove the brake caliper and support with heavy mechanics wire.



3034095

9. Remove the disc brake pads (1).



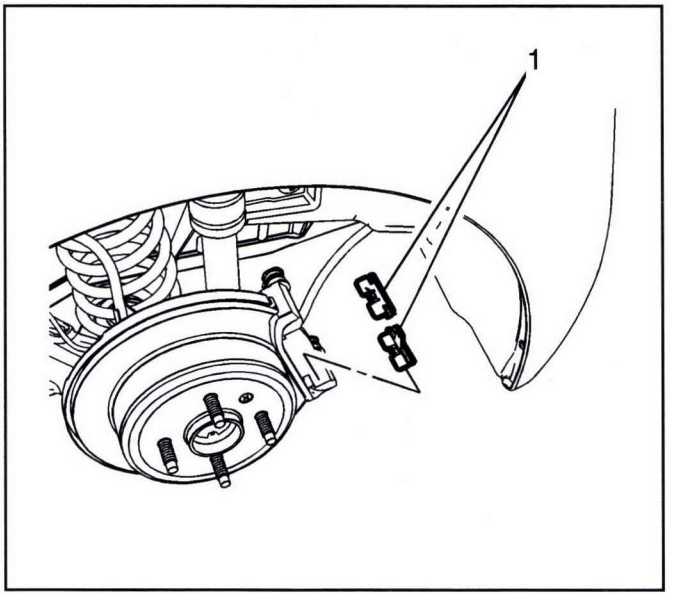
3034098

Note: If replacing the disc brake pads, discard the springs.

10. Remove the disc brake pad springs (1).

Installation Procedure

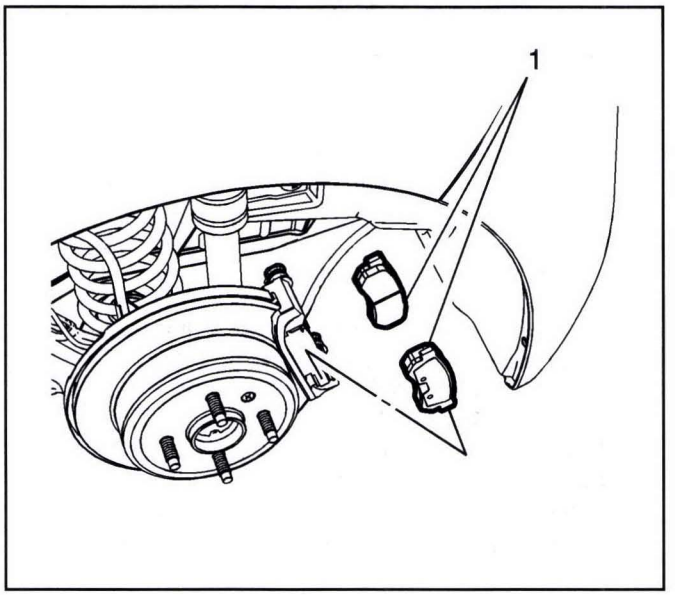
1. Thoroughly clean the contact surfaces of the brake caliper bracket of any corrosion or debris.



3034098

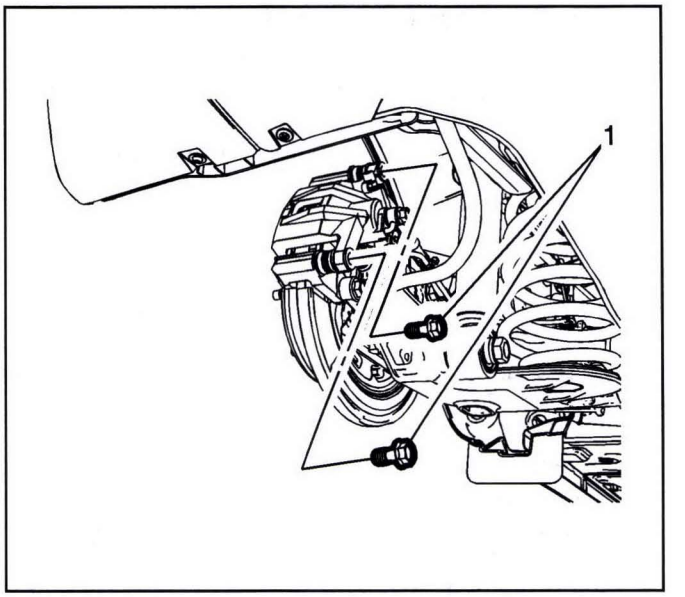
Note: If installing new brake pads, install new brake pad springs.

2. Install the disc brake pad springs (1).



3034095

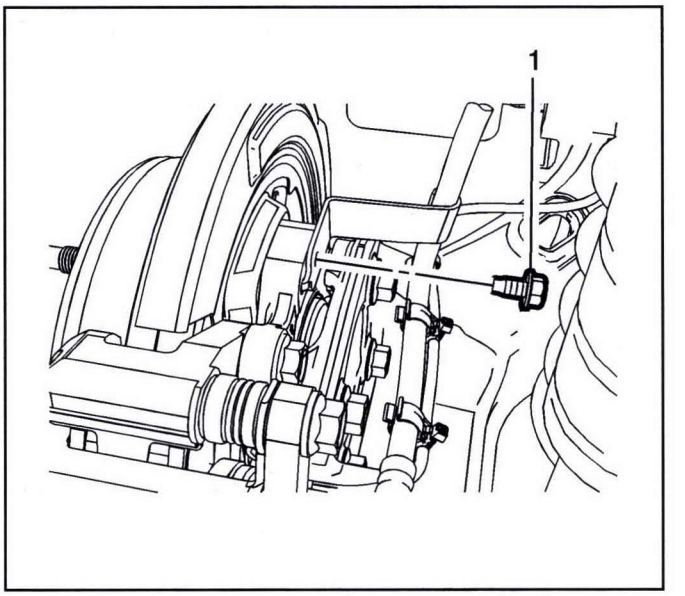
3. Install the disc brake pads (1).
4. Position the brake caliper over the disc brake pads and to the caliper bracket.



3034091

Caution: Refer to *Fastener Caution on page 0-8*.

5. Using a backup wrench to hold the brake caliper guide pins stationary, install the brake caliper guide pin bolts (1) and tighten to **28 N•m (21 lb ft)**.



3227991

6. Install the brake hose bracket bolt (1) and tighten to **9 N•m (80 lb in)**.
7. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
8. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
9. Slowly release the brake pedal.
10. Wait 15 seconds, then repeat steps 8-9 until a firm brake pedal is obtained. This will properly seat the brake caliper piston and brake pads.
11. Fill the master cylinder reservoir. Refer to *Master Cylinder Reservoir Filling on page 5-165*.
12. Burnish the brake pads and rotors. Refer to *Brake Pad and Rotor Burnishing on page 5-108*.

Brake Pad and Rotor Burnishing

Warning: Road test a vehicle under safe conditions and while obeying all traffic laws. Do not attempt any maneuvers that could jeopardize vehicle control. Failure to adhere to these precautions could lead to serious personal injury and vehicle damage.

Burnishing the brake pads and brake rotors is necessary in order to ensure that the braking surface are properly prepared after service has been performed on the disc brake system.

This procedure should be performed whenever the disc brake rotors have been refinished or replaced, and/or whenever the brake pads have been replaced.

1. Select a smooth road with little or no traffic.
2. Accelerate the vehicle to 48 km/h (30 mph).

   Note: Use care to avoid overheating the brakes while performing this step as it may adversely affect the heating characteristics of the NEW brake pad material.
3. Using moderate pressure, apply the brakes to bring the vehicle to a stop. Do not allow the brakes to lock.
4. Repeat steps 2 and 3 until approximately 20 stops have been completed. Allow sufficient cooling periods between stops in order to properly burnish the brake pads and rotors.

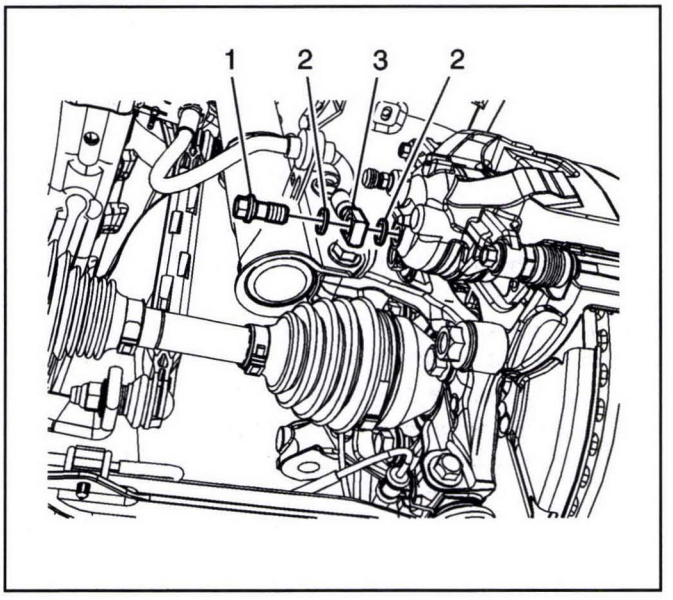
Front Brake Caliper Replacement

Removal Procedure

Warning: Refer to Brake Dust Warning on page 0-4.

Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

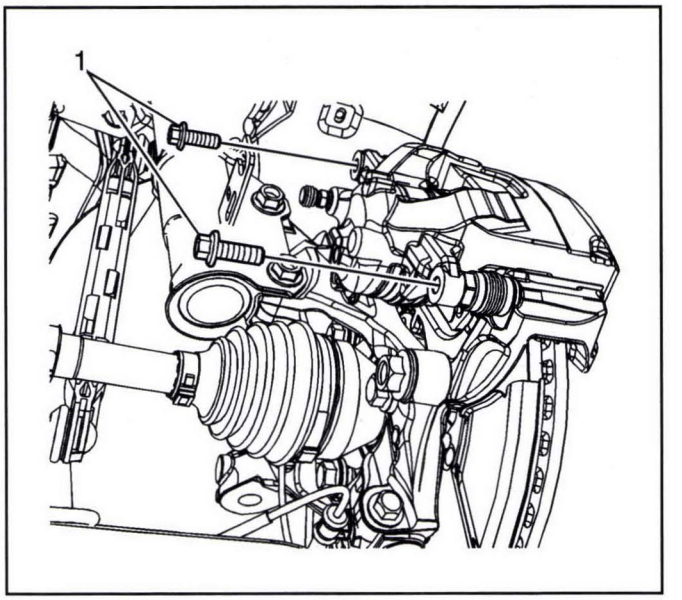
1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.



2375918

3. Remove the brake hose fitting bolt (1).

   Note: Do not reuse the brake hose fitting gaskets.
4. Remove and discard the brake hose fitting gaskets (2) from the brake hose fitting (3).
5. Cap the brake hose fitting to prevent brake fluid loss and contamination.



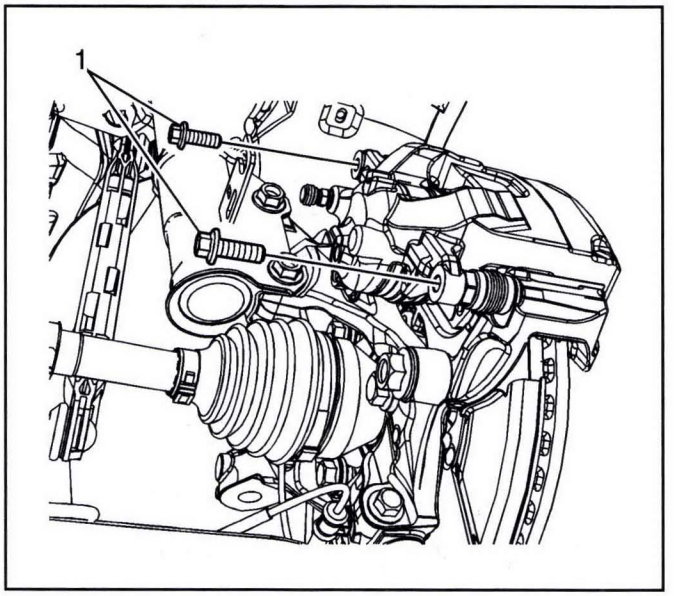
2375919

Note:

- DO NOT use any air tools to remove or install the guide pin bolts. Use hand tools ONLY.
- Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt. DO NOT allow the open end wrench to come in contact with the brake caliper. Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.

6. Using a backup wrench to hold the brake caliper guide pin stationary, remove the brake caliper guide pin bolts (1).
7. Remove the brake caliper.

Installation Procedure

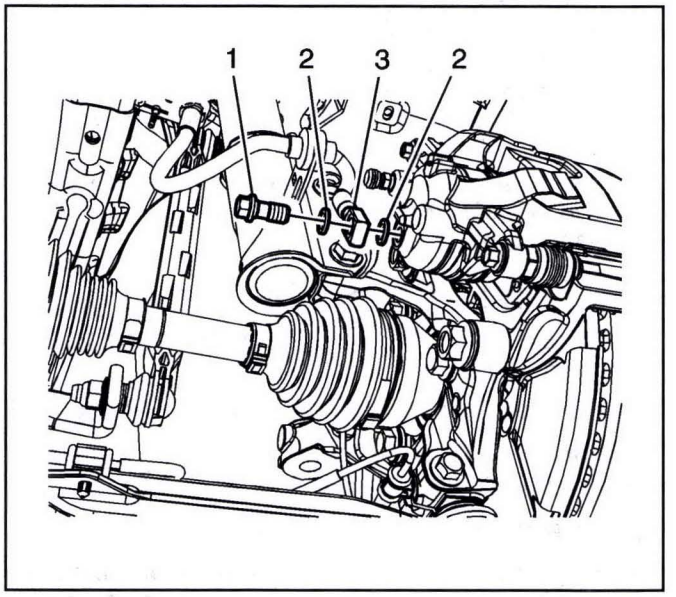


2375919

1. Position the brake caliper over the brake pads and to the caliper bracket.

Caution: Refer to *Fastener Caution on page 0-8*.

2. Using a backup wrench to hold the brake caliper guide pin stationary, install the brake caliper guide pin bolts (1) and tighten to **28** N•m **(21 lb ft)**.



2375918

Note: Install new brake hose fitting gaskets.

3. Assemble the brake hose fitting bolt (1) and the 2 new brake hose fitting gaskets (2) to the brake hose fitting (3).
4. Install the brake hose assembly and tighten the brake hose fitting bolt to **40** N•m **(30 lb ft)**.
5. Bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*.
6. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.

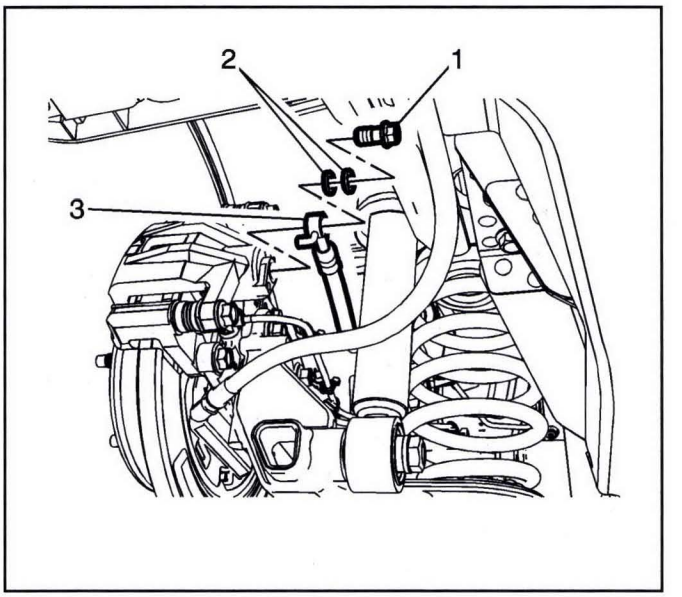
Rear Brake Caliper Replacement

Removal Procedure

Warning: Refer to Brake Dust Warning on page 0-4.

Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

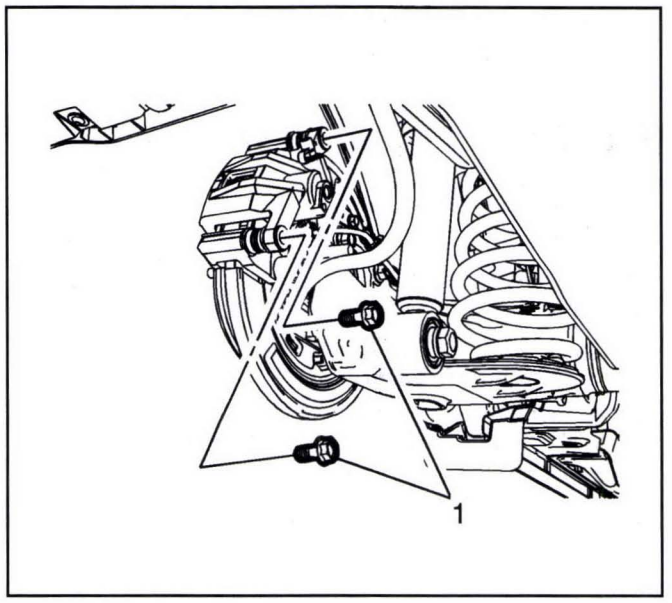
1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.



3034099

3. Remove the brake hose fitting bolt (1).

   Note: Do not reuse the brake hose fitting gaskets.
4. Remove and discard the brake hose fitting gaskets (2) from the brake hose fitting (3).
5. Cap the brake hose fitting to prevent brake fluid loss and contamination.



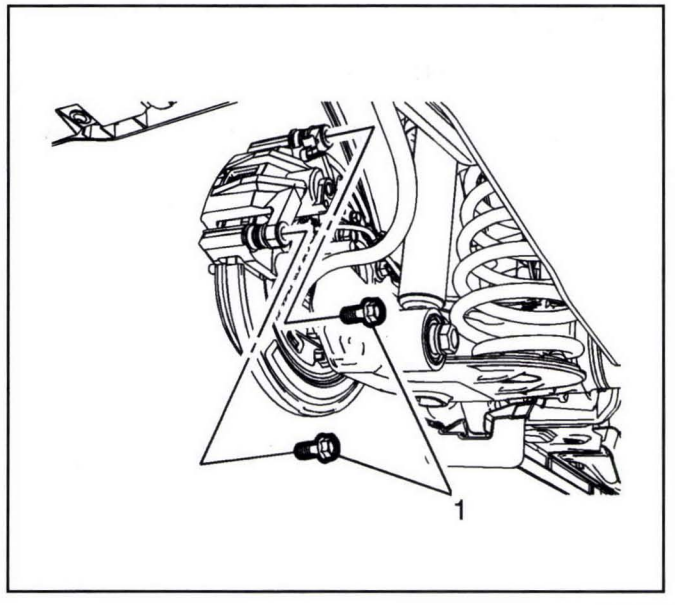
3034102

Note:

- DO NOT use any air tools to remove or install the guide pin bolts. Use hand tools ONLY.
- Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt. DO NOT allow the open end wrench to come in contact with the brake caliper. Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.

6. Using a backup wrench to hold the brake caliper guide pin stationary, remove the brake caliper guide pin bolts (1).
7. Remove the brake caliper.

Installation Procedure

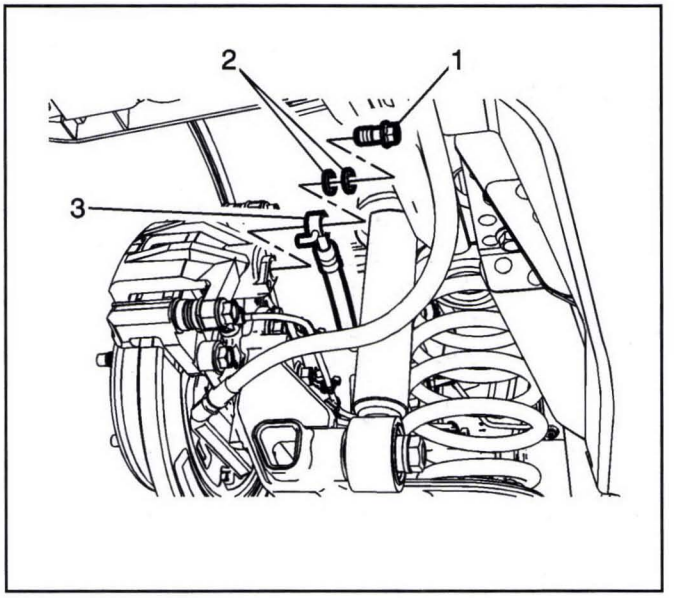


3034102

1. Position the brake caliper over the brake pads and to the caliper bracket.

Caution: Refer to *Fastener Caution on page 0-8*.

2. Using a backup wrench to hold the brake caliper guide pin stationary, install the brake caliper guide pin bolts (1) and tighten to **28** N•m **(21 lb ft)**.



3034099

Note: Install new brake hose fitting gaskets.

3. Assemble the brake hose fitting bolt (1) and the 2 new brake hose fitting gaskets (2) to the brake hose fitting (3).
4. Install the brake hose assembly and tighten the brake hose fitting bolt to **40** N•m **(30 lb ft)**.
5. Bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*.
6. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.

Front Brake Caliper Overhaul

Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Warning: Refer to Brake Dust Warning on page 0-4.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

Disassembly Procedure

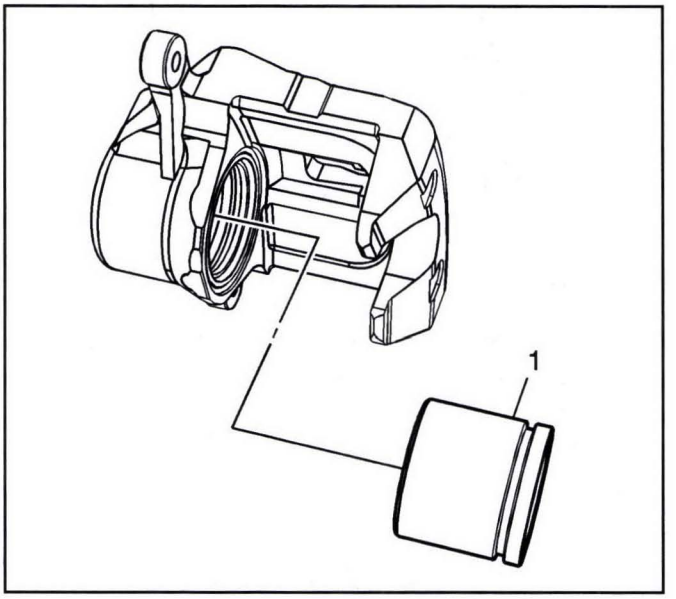
Warning: Do not place fingers in front of the caliper piston(s) in an attempt to catch or protect it when applying compressed air. The piston(s) can fly out with force and could result in serious bodily injury.

Note:

- Replace all the components included in the repair kits used to service this brake caliper.
- Lubricate the rubber parts with GM approved brake fluid from a clean, sealed brake fluid container to make assembly easier.

- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- The torque values specified are for dry, non-lubricated fasteners.
- Perform the service operations on a clean bench, free from all mineral oil materials.

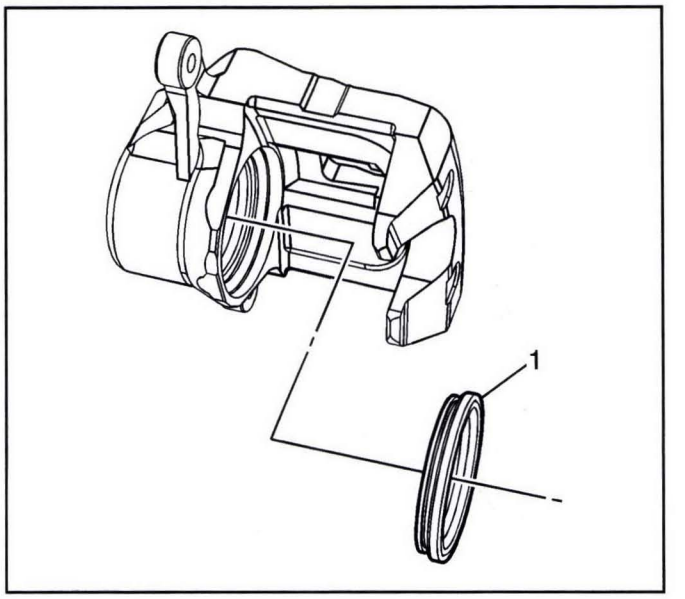
1. Remove the brake caliper from the vehicle. Refer to *Front Brake Caliper Replacement on page 5-108*.
2. Drain the brake fluid from the brake caliper.



2201930

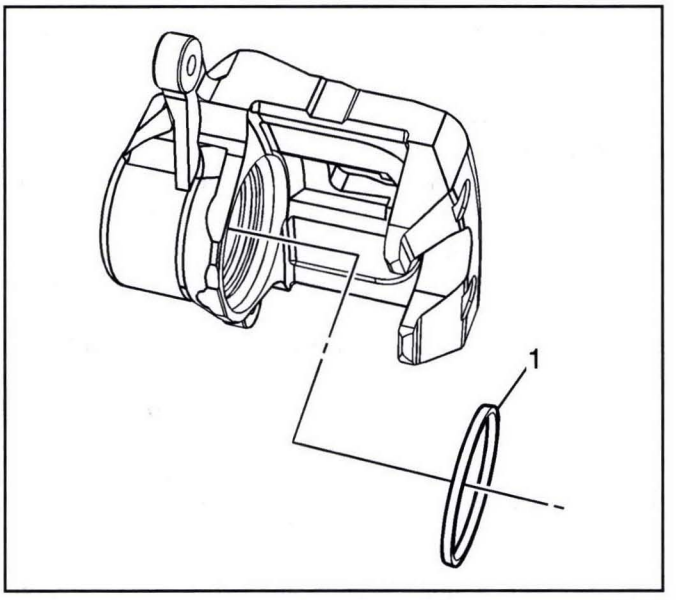
Caution: Use clean cloths to pad interior of caliper housing during piston removal. Use just enough air to ease the pistons out of the bores. If the pistons are blown out, even with the padding provided, it may be damaged.

3. Place a 25 mm (1 in) block of wood between the caliper housing and the piston.
4. Place clean shop cloths between the caliper piston and the block of wood.
5. Carefully remove the brake caliper piston (1) by directing low pressure compressed air into the brake caliper inlet hole.
6. Remove the shop cloths and the block of wood from the caliper.



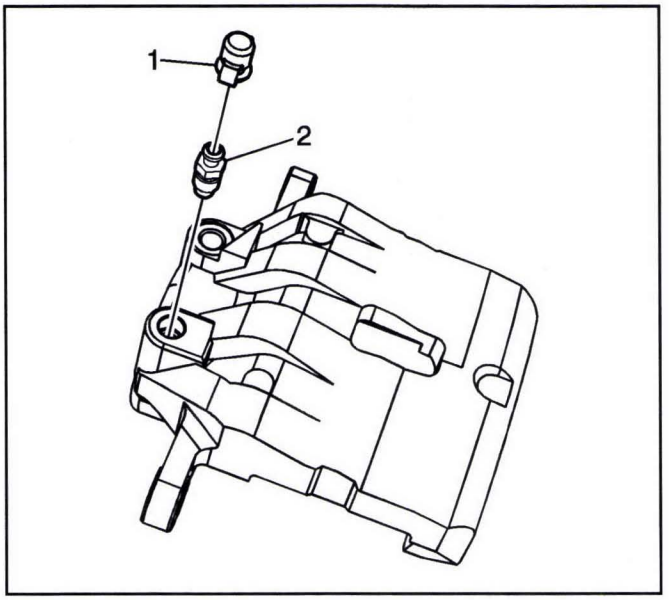
2201931

7. Remove the piston dust boot seal (1) from the seal counterbore in the brake caliper and discard the dust boot seal.



2201934

8. Using a small wooden or plastic tool, remove the piston seal (1) from the brake caliper bore and discard the piston seal.



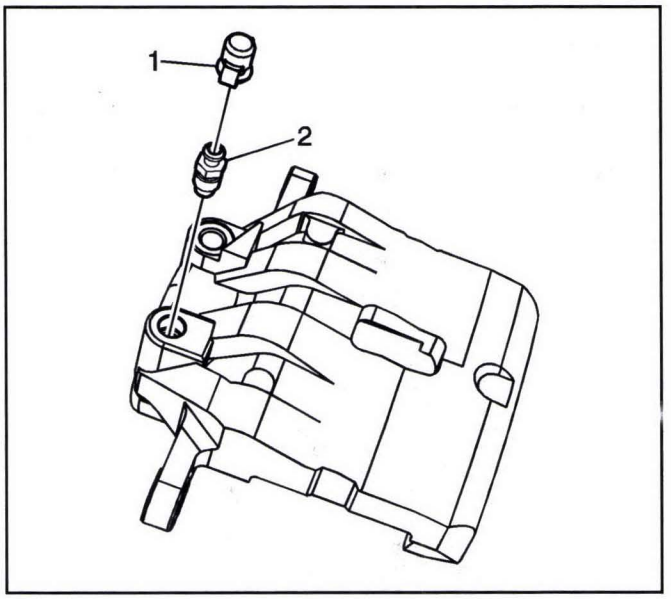
2201935

9. Remove the brake caliper bleeder valve cap (1) and bleeder valve (2).

   Note: Do not use abrasives to clean the brake caliper pistons.

10. Inspect the brake caliper mounting bracket guide surfaces for corrosion and wear. Remove and replace the brake caliper mounting bracket if damaged or worn.
11. Clean the brake caliper piston bores and seal counterbore with denatured alcohol, or equivalent.
12. Clean the brake caliper piston with denatured alcohol, or equivalent.
13. Dry the caliper piston bore and counterbore with non-lubricated, filtered air.
14. Dry the brake caliper piston with non-lubricated, filtered air.
15. Inspect the caliper bore for cracks, scoring, pitting, excessive corrosion.
16. If light corrosion is present in the caliper bore, attempt to remove the imperfection with a fine emery paper. If the imperfection cannot be removed, replace the caliper assembly.
17. If cracks, scoring, pitting, and excessive corrosion are present in the caliper bore, replace the caliper assembly.
18. Inspect the caliper piston for cracks, scoring, and/or damage. Replace the caliper piston if any of these conditions exist.

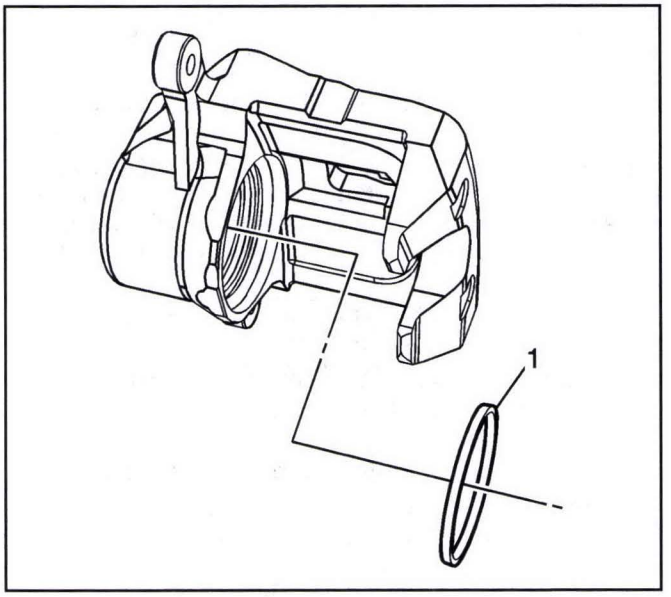
Assembly Procedure



2201935

Caution: Refer to *Fastener Caution on page 0-8*.

1. Install the brake caliper bleeder valve (2) and tighten to **10** N•m **(89 lb in)**.
2. Install the brake caliper bleeder valve cap (1).



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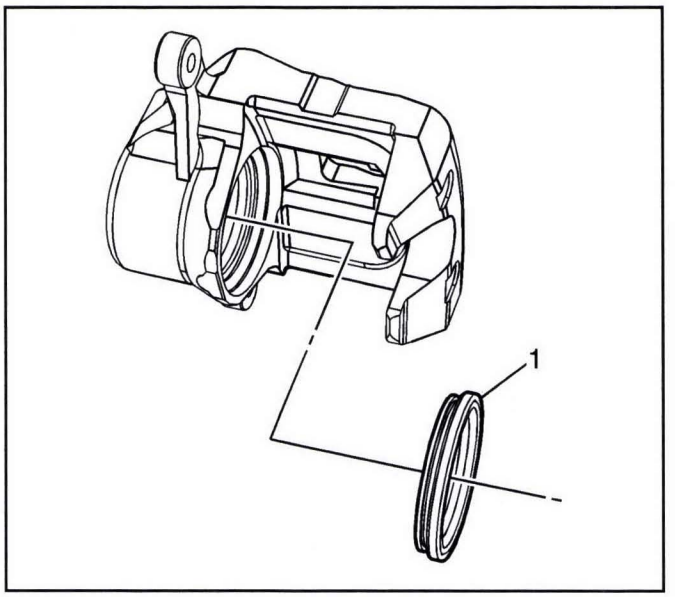
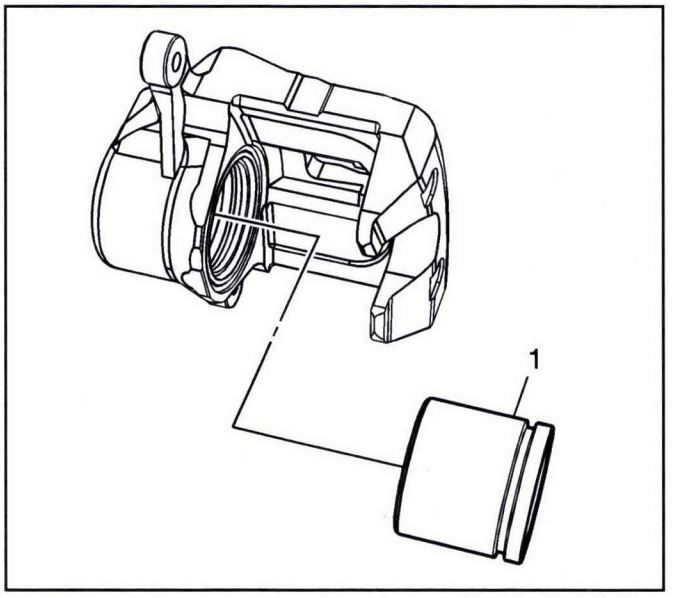
3. Lubricate the new piston seal (1) with GM approved brake fluid from a clean, sealed brake fluid container.
4. Install lubricated piston seal into the brake caliper bore seal groove.

   Ensure the seal is not twisted.



2201931

5. Install the piston dust boot seal (1) to the caliper. Ensure the seal is seated evenly and completely into the groove in the caliper housing.



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6. Place the caliper piston into the caliper housing by carefully lifting the edge of the dust boot seal.
7. Carefully push the piston (1) squarely into the brake caliper bore.
8. Ensure the caliper dust boot is properly seated into the piston groove and into the groove in the brake caliper bore.
9. Install the brake caliper to the vehicle. Refer to *Front Brake Caliper Replacement on page 5-108*.

Rear Brake Caliper Overhaul

Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Warning: Refer to Brake Dust Warning on page 0-4.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

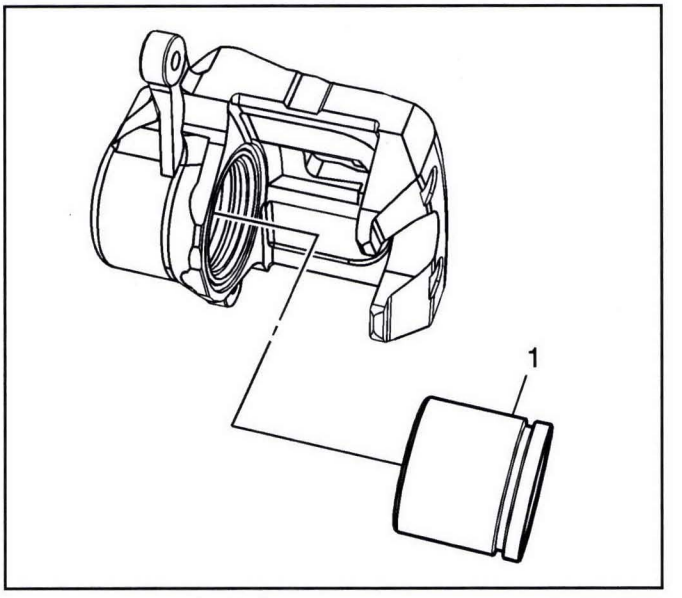
Disassembly Procedure

Warning: Do not place fingers in front of the caliper piston(s) in an attempt to catch or protect it when applying compressed air. The piston(s) can fly out with force and could result in serious bodily injury.

Note:

- Replace all the components included in the repair kits used to service this brake caliper.
- Lubricate the rubber parts with GM approved brake fluid from a clean, sealed brake fluid container to make assembly easier.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- The torque values specified are for dry, non-lubricated fasteners.
- Perform the service operations on a clean bench, free from all mineral oil materials.

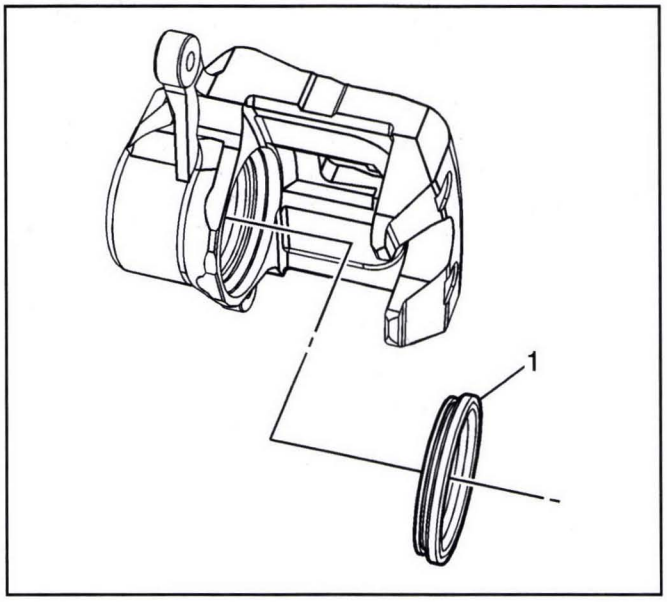
1. Remove the brake caliper from the vehicle. Refer to *Rear Brake Caliper Replacement on page 5-109*.
2. Drain the brake fluid from the brake caliper.



2201930

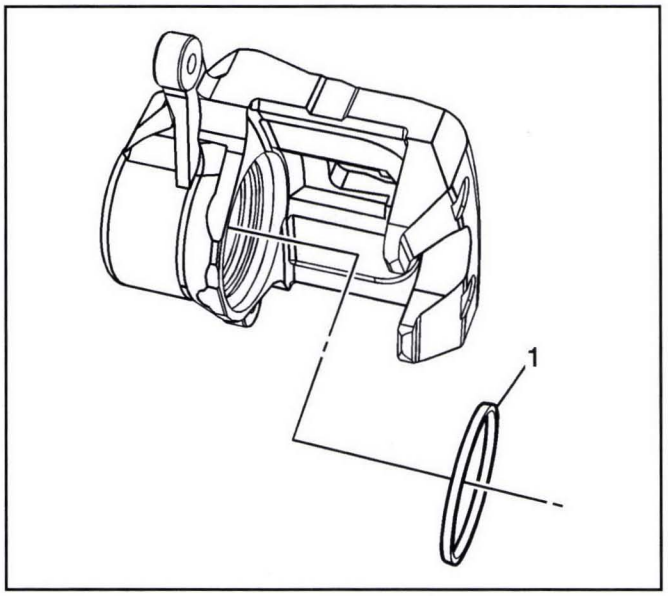
Caution: Use clean cloths to pad interior of caliper housing during piston removal. Use just enough air to ease the pistons out of the bores. If the pistons are blown out, even with the padding provided, it may be damaged.

3. Place a 25 mm (1 in) block of wood between the caliper housing and the piston.
4. Place clean shop cloths between the caliper piston and the block of wood.
5. Carefully remove the brake caliper piston (1) by directing low pressure compressed air into the brake caliper inlet hole.
6. Remove the shop cloths and the block of wood from the caliper.



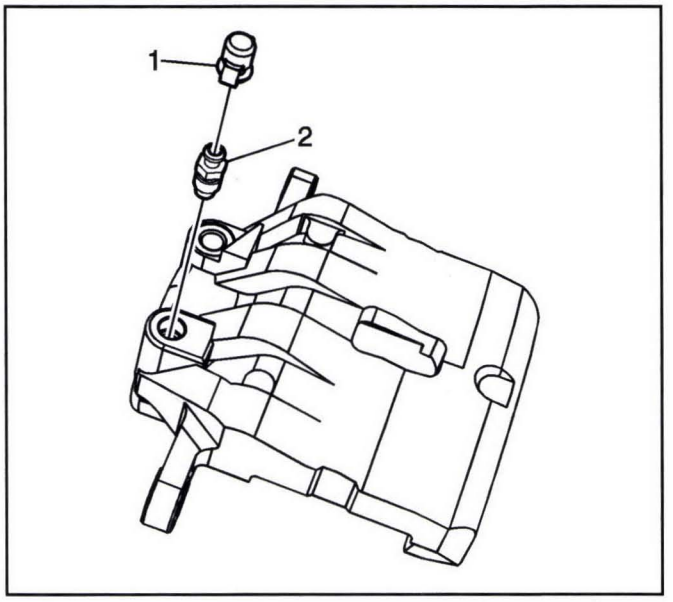
2201931

7. Remove the piston dust boot seal (1) from the seal counterbore in the brake caliper.



2201934

8. Using a small wooden or plastic tool, remove the piston seal (1) from the brake caliper bore and discard the piston seal.



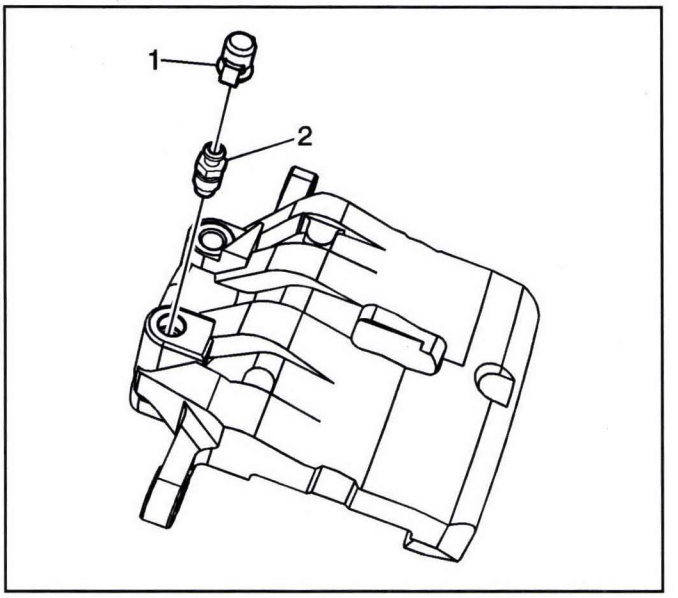
2201935

9. Remove the brake caliper bleeder valve cap (1) and bleeder valve (2).

   Note: Do not use abrasives to clean the brake caliper pistons.

10. Inspect the brake caliper mounting bracket guide surfaces for corrosion and wear. Remove and replace the brake caliper mounting bracket if damaged or worn.
11. Clean the brake caliper piston bore and seal counterbore with denatured alcohol, or equivalent.
12. Clean the brake caliper piston with denatured alcohol, or equivalent.
13. Dry the caliper piston bore and counterbore with non-lubricated, filtered air.
14. Dry the brake caliper piston with non-lubricated, filtered air.
15. Inspect the caliper bore for cracks, scoring, pitting, excessive corrosion.
16. If light corrosion is present in the caliper bore, attempt to remove the imperfection with a fine emery paper. If the imperfection cannot be removed, replace the caliper assembly.
17. If cracks, scoring, pitting, and excessive corrosion are present in the caliper bore, replace the caliper assembly.
18. Inspect the caliper piston for cracks, scoring, and/or damage. Replace the caliper if any of these conditions exist.

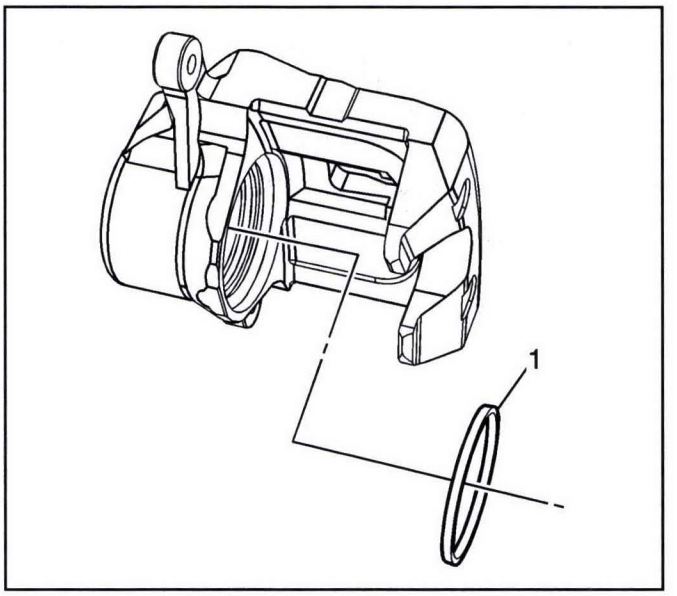
Assembly Procedure



2201935

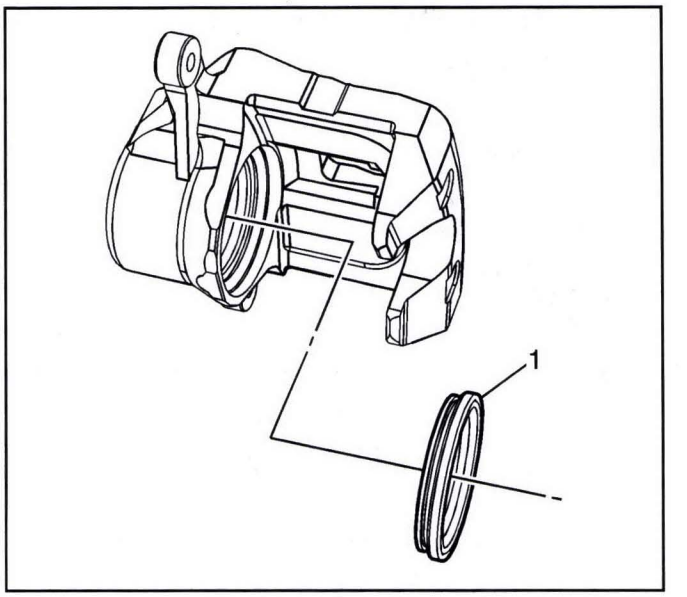
Caution: Refer to *Fastener Caution on page 0-8*.

1. Install the brake caliper bleeder valve (2) and tighten to **10 N•m (89 lb in)**.
2. Install the brake caliper bleeder valve cap (1).



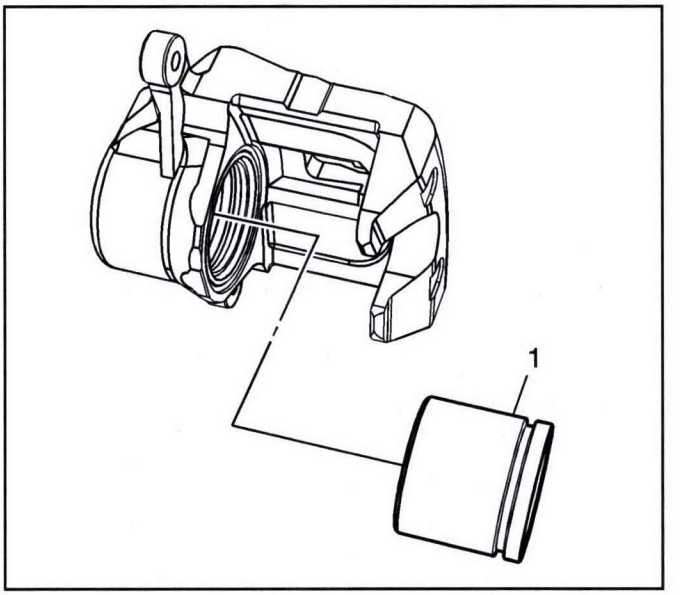
2201934

3. Lubricate the new piston seal (1) with GM approved brake fluid from a clean, sealed brake fluid container.
4. Install lubricated piston seal into the brake caliper bore seal groove.
5. Ensure the seal is not twisted.



2201931

6. Install the piston dust boot seal (1) to the caliper.
7. Ensure the seal is seated evenly and completely into the groove in the caliper housing.



2201930

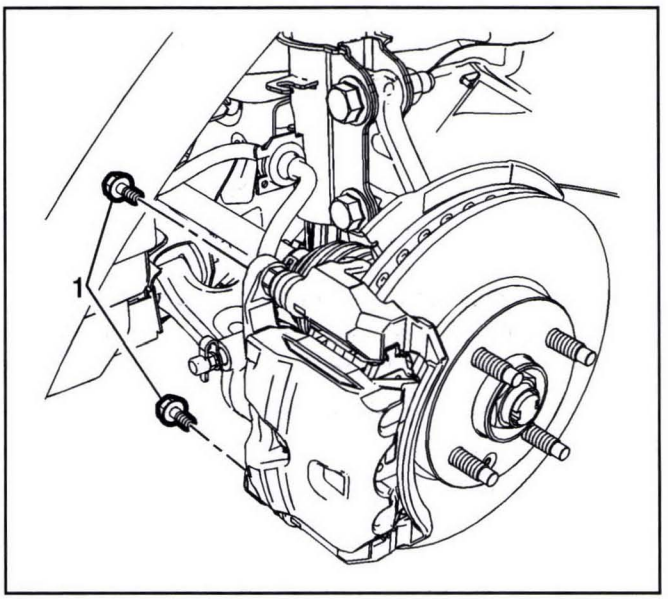
8. Place the caliper piston into the caliper housing by carefully lifting the edge of the dust boot seal.
9. Carefully push the piston (1) squarely into the brake caliper bore.
10. Ensure the caliper dust boot is properly seated into the piston groove and into the groove in the brake caliper bore.
11. Install the brake caliper to the vehicle. Refer to *Rear Brake Caliper Replacement on page 5-109*.

Front Brake Caliper Bracket Replacement

Removal Procedure

Warning: Refer to Brake Dust Warning on page 0-4.

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.



2537417

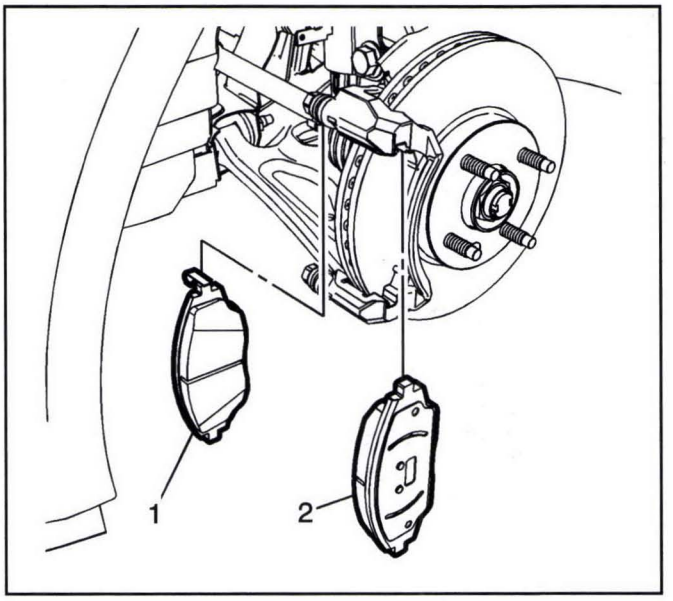
Note:

- DO NOT use any air tools to remove or install the guide pin bolts. Use hand tools ONLY.
- Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt. DO NOT allow the open end wrench to come in contact with the brake caliper. Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.

3. Hold the brake caliper guide pin stationary and remove the brake caliper guide pin bolts (1).

Caution: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

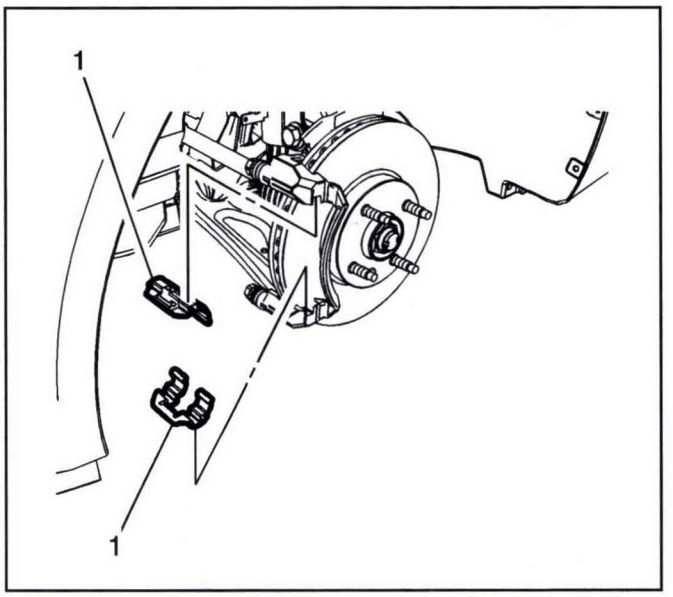
4. Remove the brake caliper and support with heavy mechanics wire or equivalent.



2537420

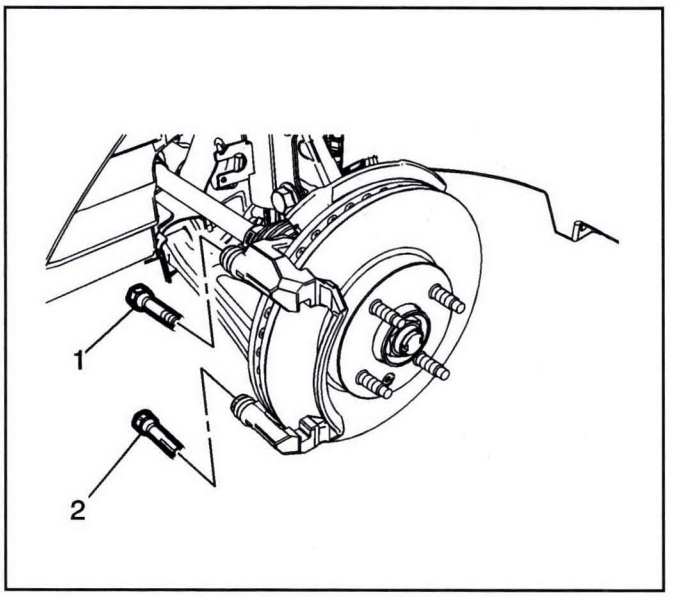
Note: Note the location of the wear sensor for correct installation.

5. Remove the inner disc brake pad (1).
6. Remove the outer disc brake pad (2).



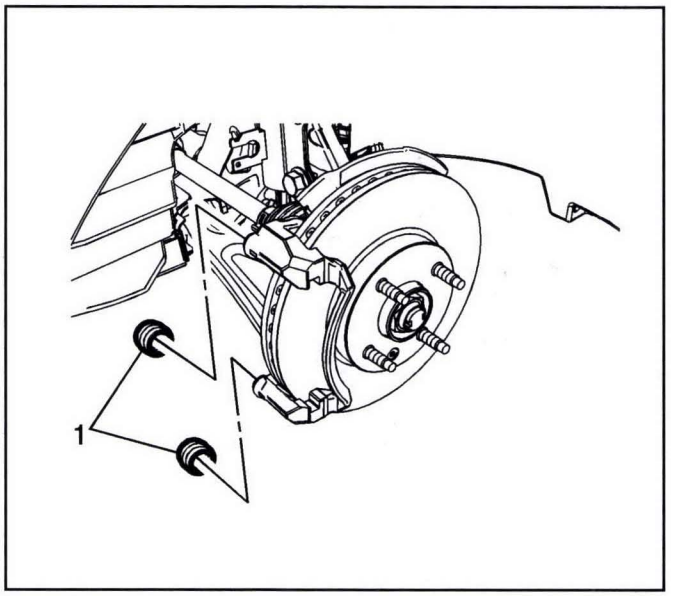
2537421

7. Remove the disc brake pad springs (1).



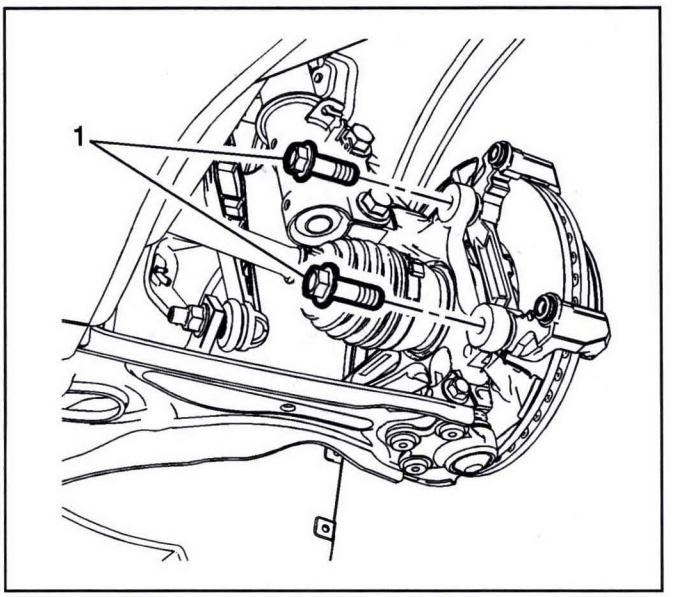
2537422

8. Remove the upper brake caliper guide pin (1).
9. Remove the lower brake caliper guide pin (2).



2537423

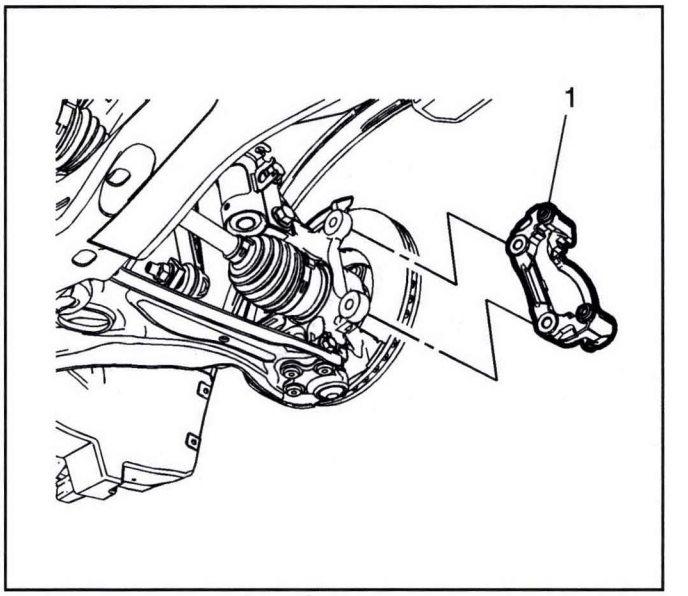
10. Remove the brake caliper guide pin seals (1).



2537424

Note: Do not reuse the brake caliper bracket bolts.

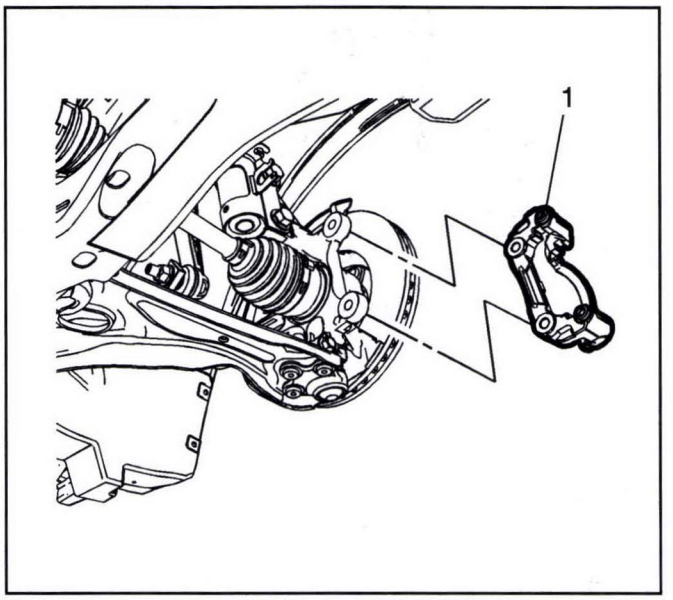
11. Remove and discard the brake caliper bracket bolts (1).



2537425

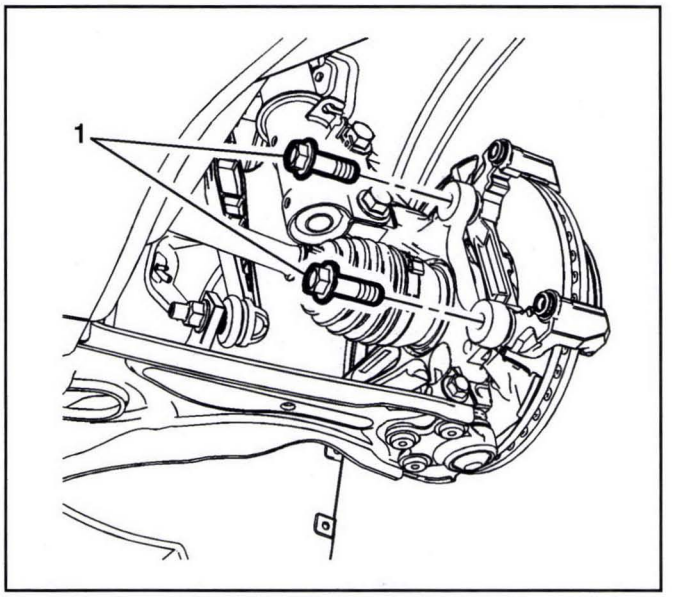
12. Remove the brake caliper bracket (1).
13. Inspect the brake caliper bracket and hardware for excessive wear or damage. Refer to *Front Disc Brake Mounting and Hardware Inspection on page 5-101*.

Installation Procedure



2537425

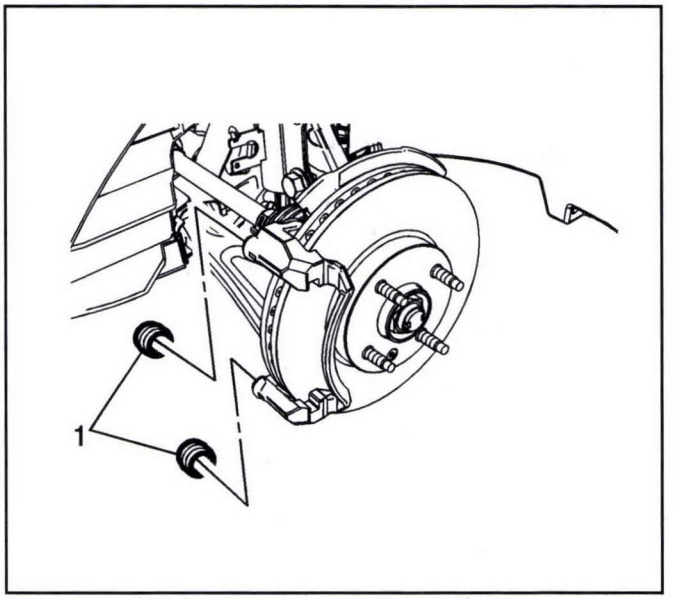
1. Install the brake caliper bracket (1).



2537424

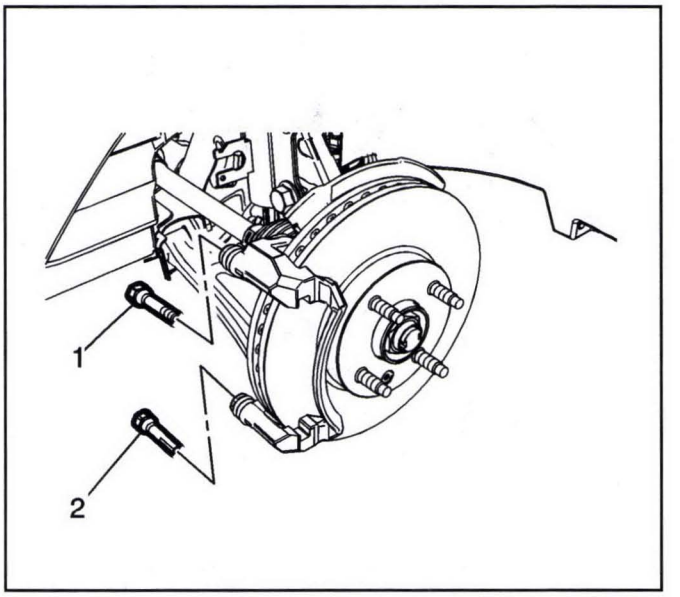
Caution: Refer to *Fastener Caution on page 0-8*.

2. Install new brake caliper bracket bolts (1) and tighten to **95** N•m **(70 lb ft)**.



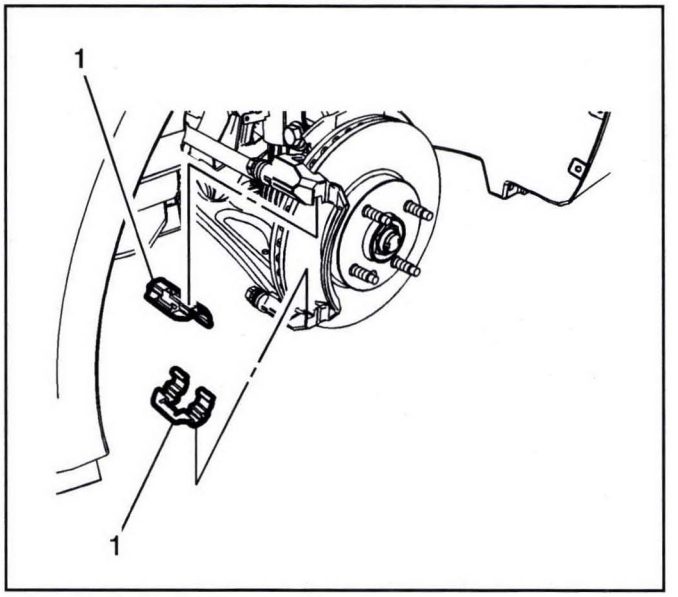
2537423

3. Install the brake caliper guide pin seals (1).
4. Ensure the brake caliper guide pin seals are fully seated in the groove of the brake caliper bracket.



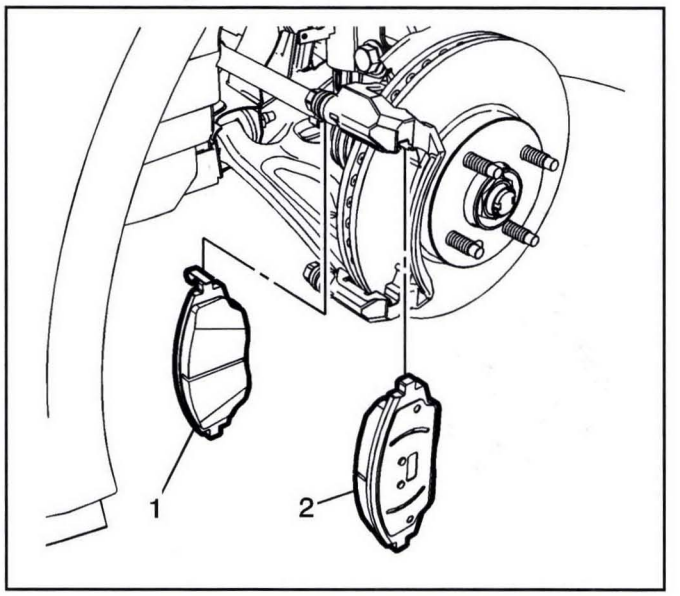
2537422

5. Install the upper brake caliper guide pin (1).
6. Install the lower brake caliper guide pin (2).
7. Ensure the brake caliper guide pin seals are fully seated in the groove of the brake caliper guide pins.



2537421

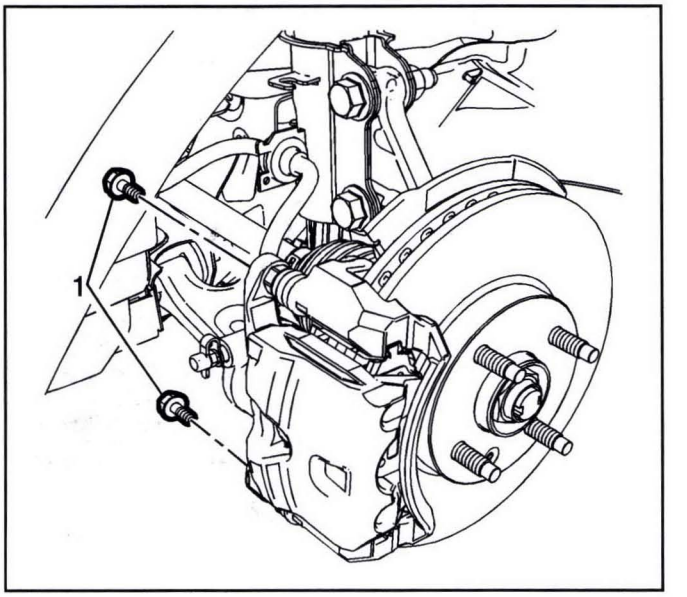
8. Install the disc brake pad springs (1).



2537420

Note: Note the location of the wear sensor for correct installation.

9. Install the inner disc brake pad (1).
10. Install the outer disc brake pad (2).
11. Position the brake caliper over the brake pads and to the caliper bracket.



2537417

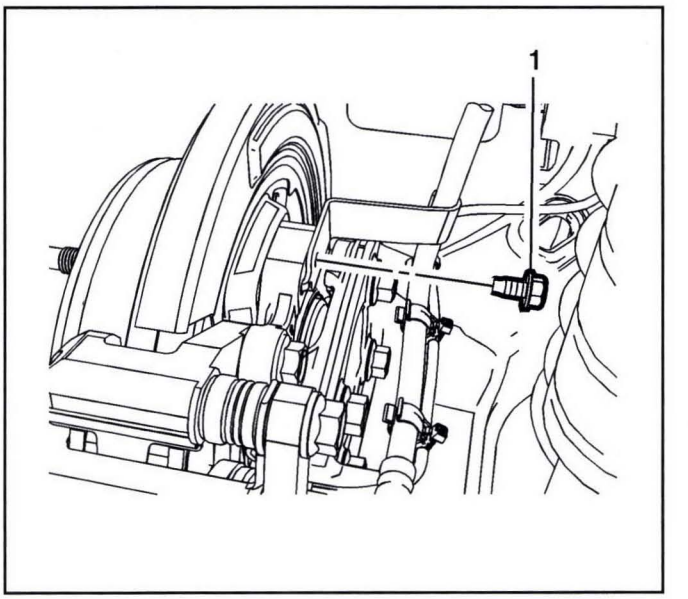
12. Using a backup wrench to hold the brake caliper guide pin stationary, install the brake caliper guide pin bolts (1) and tighten to **28 N•m (21 lb ft)**.
13. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.

Rear Brake Caliper Bracket Replacement

Removal Procedure

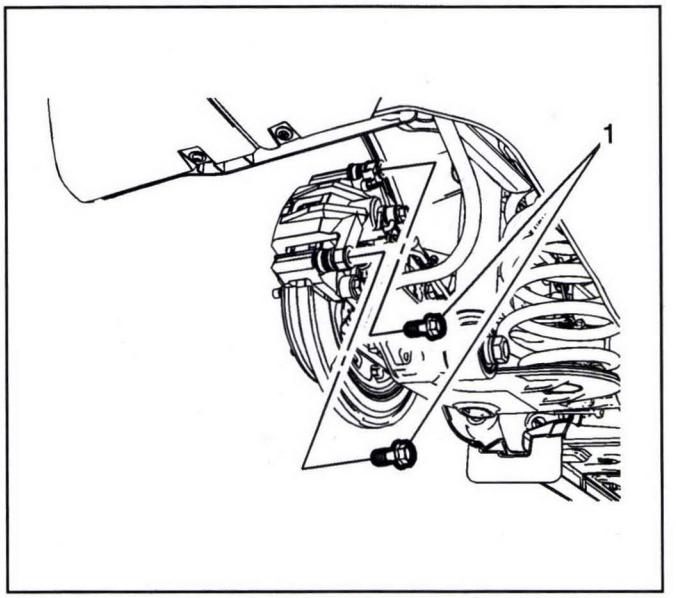
Warning: Refer to Brake Dust Warning on page 0-4.

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.



3227991

3. Remove the brake hose bracket bolt (1).



3034091

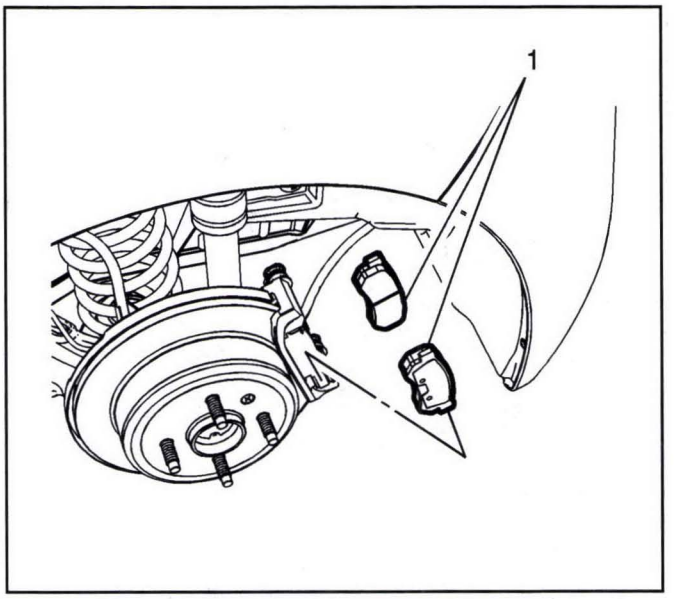
Note:

- DO NOT use any air tools to remove or install the guide pin bolts. Use hand tools ONLY.
- Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt. DO NOT allow the open end wrench to come in contact with the brake caliper. Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.

4. Using a backup wrench to hold the brake caliper guide pins stationary, remove the brake caliper guide pin bolts (1).

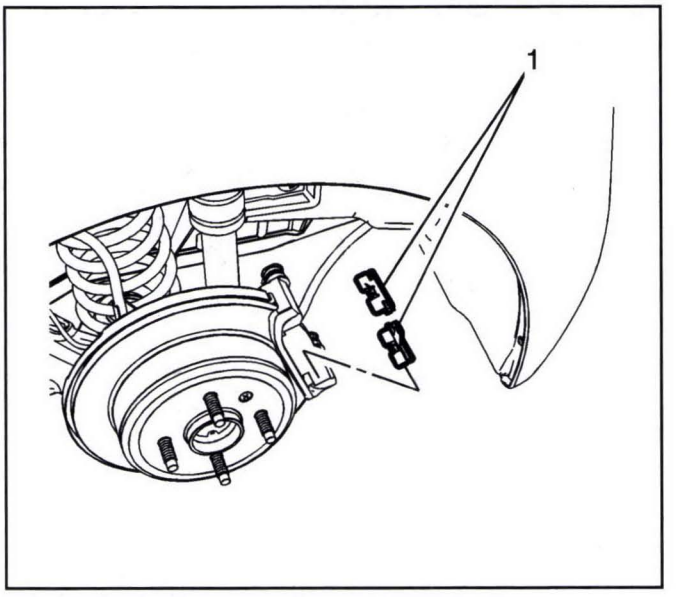
Caution: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

5. Remove the brake caliper and support with heavy mechanics wire.



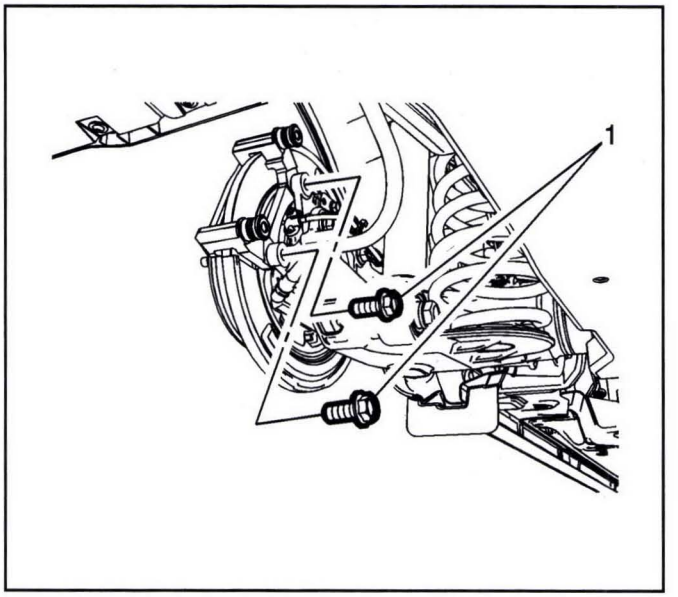
3034095

6. Remove the disc brake pads (1).



3034098

7. Remove the disc brake pad springs (1).



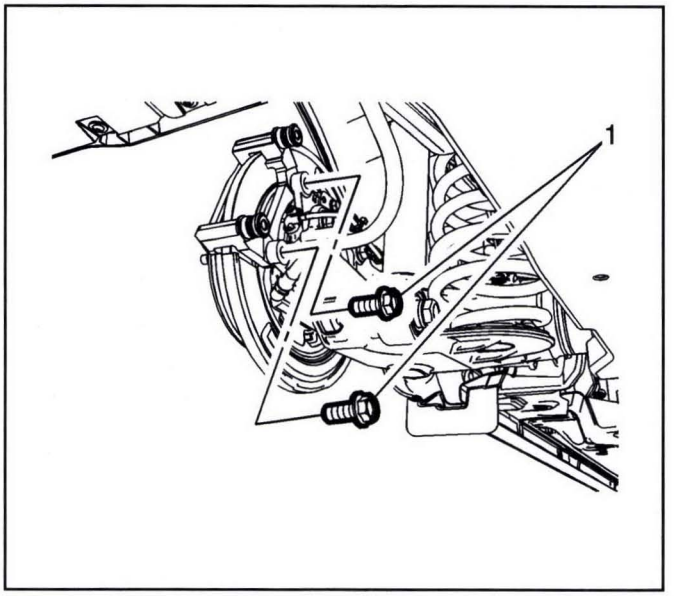
3034105

Note: Do not reuse the brake caliper bracket bolts.

8. Remove and discard the brake caliper bracket bolts (1).
9. Remove the rear brake caliper bracket.

Installation Procedure

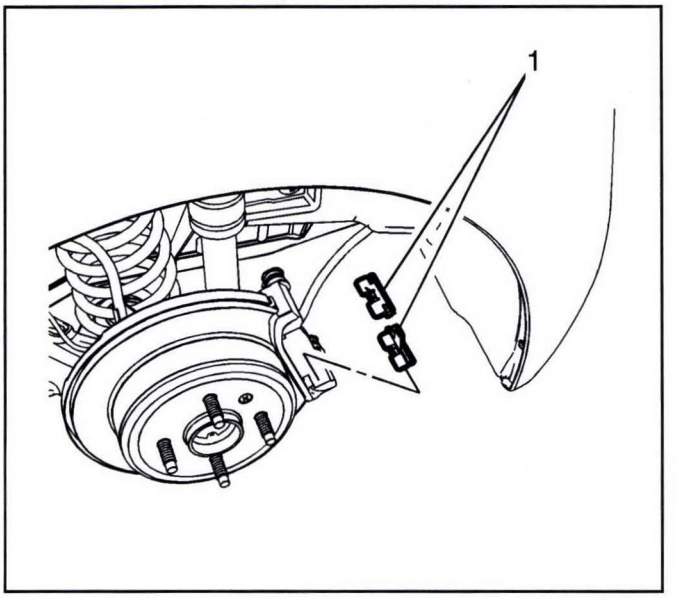
1. Install the rear brake caliper bracket.



3034105

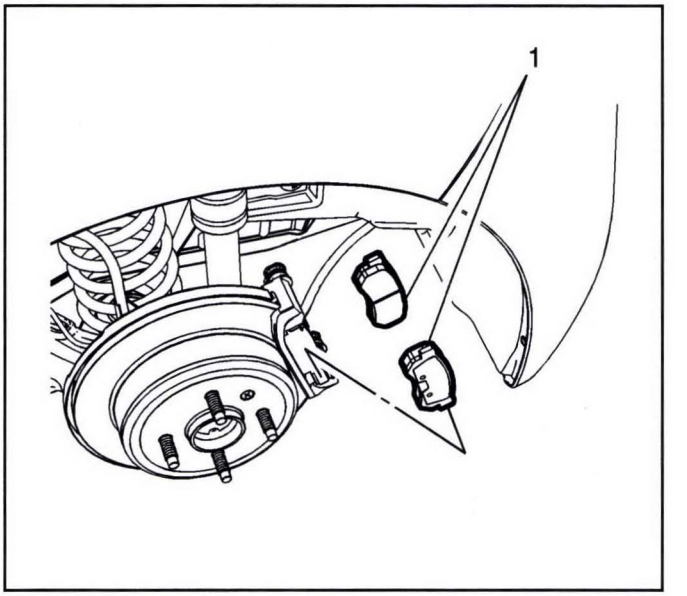
Caution: Refer to *Fastener Caution on page 0-8*.

2. Install new brake caliper bracket bolts (1) and tighten to **56** N•m **(41 lb ft)**.



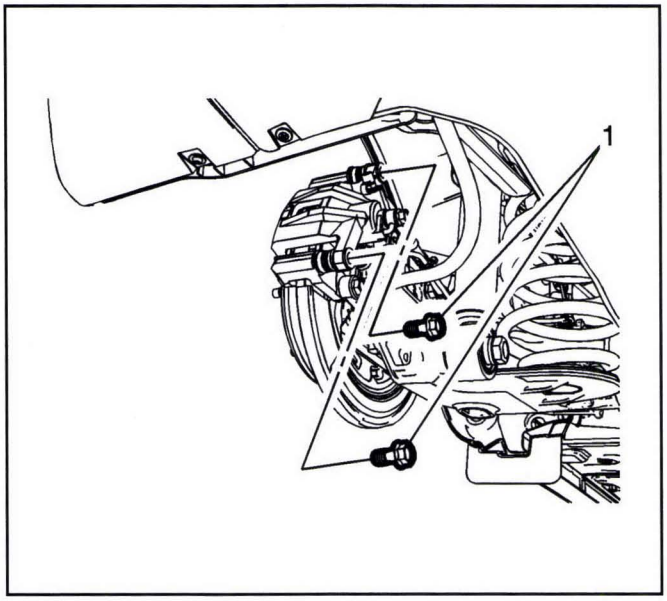
3034098

3. Install the disc brake pad springs (1).



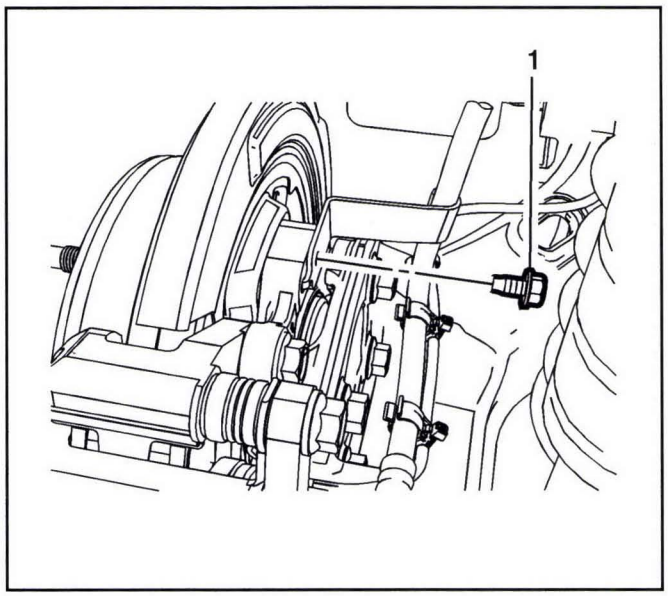
3034095

4. Install the disc brake pads (1).
5. Position the brake caliper over the disc brake pads and to the caliper bracket.



3034091

6. Using a backup wrench to hold the brake caliper guide pins stationary, install the brake caliper guide pin bolts (1) and tighten to **28 N•m (21 lb ft)**.



3227991

7. Install the brake hose bracket bolt (1) and tighten to **9 N•m (80 lb in)**.
8. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.

Front Brake Rotor Replacement

Special Tools

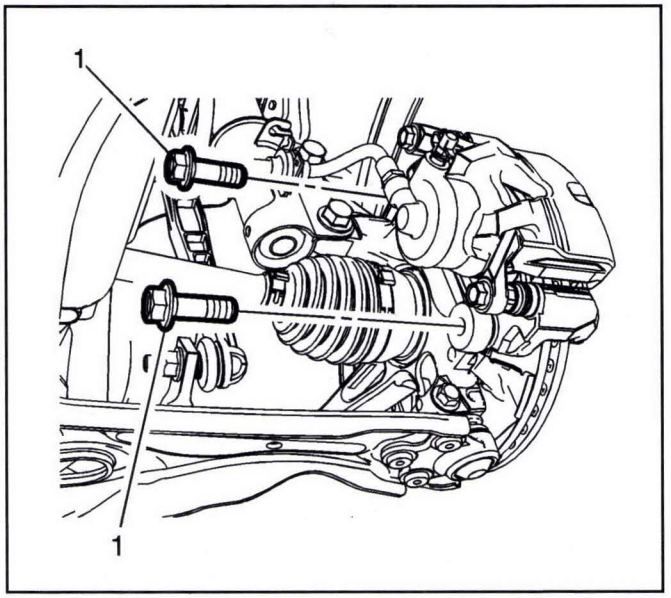
- *CH-41013* Rotor Resurfacing Kit
- *CH-42450-A* Wheel Hub Resurfacing Kit

For equivalent regional tools, refer to *Special Tools on page 5-132*.

Removal Procedure

Warning: Refer to Brake Dust Warning on page 0-4.

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.



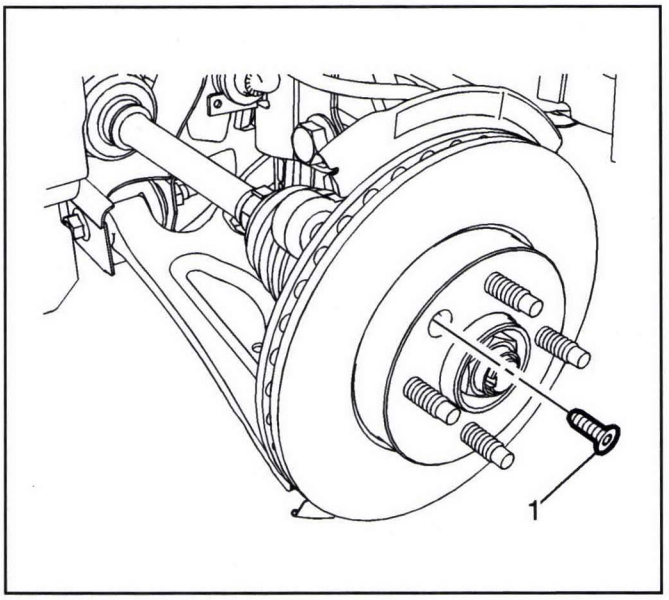
2537426

Note: Do not reuse the brake caliper bracket bolts.

3. Remove and discard the brake caliper bracket bolts (1).

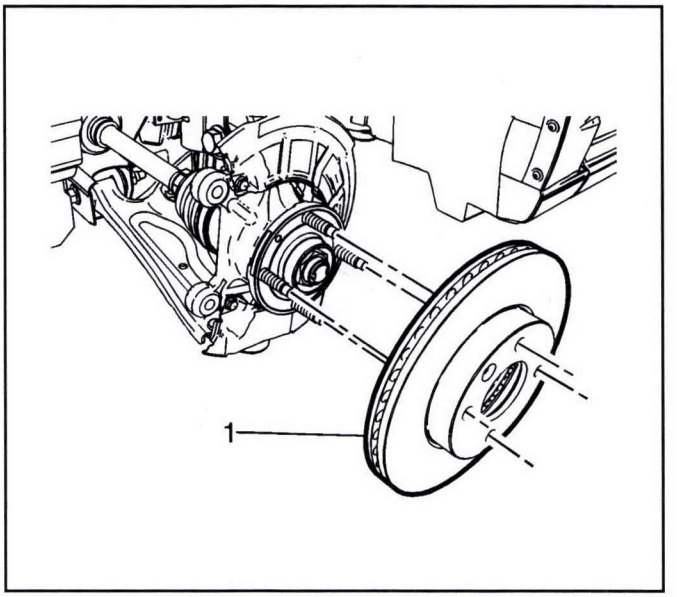
Caution: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

4. Remove the brake caliper and bracket assembly and support with heavy mechanics wire.



2506042

5. Remove the brake rotor bolt (1).

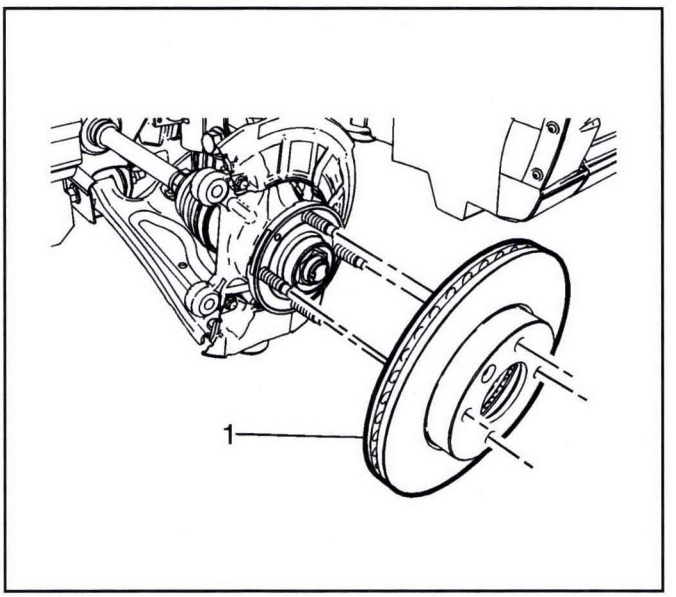


2506043

6. Remove the brake rotor (1).

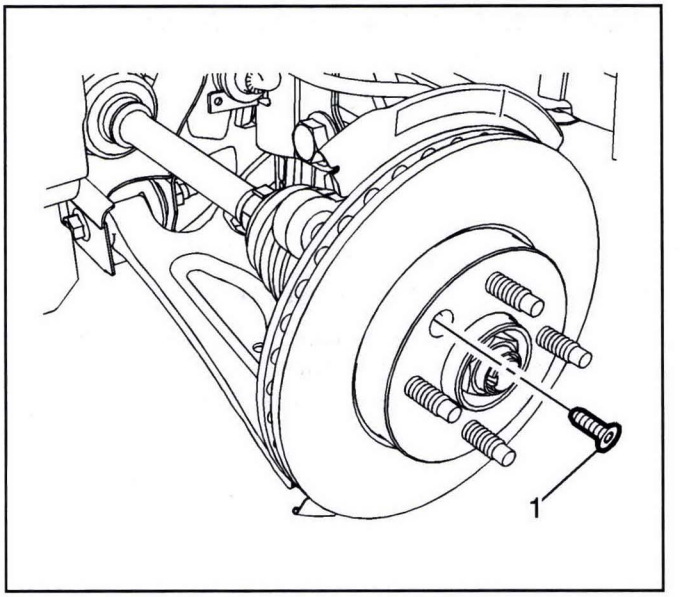
Installation Procedure

1. If installing a new brake rotor, clean the friction surfaces of the brake rotor with denatured alcohol or equivalent.
2. Using the *CH-42450-A* Wheel Hub Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange.
3. Using the *CH-41013* Rotor Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the rotor to the hub/axle flange.



2506043

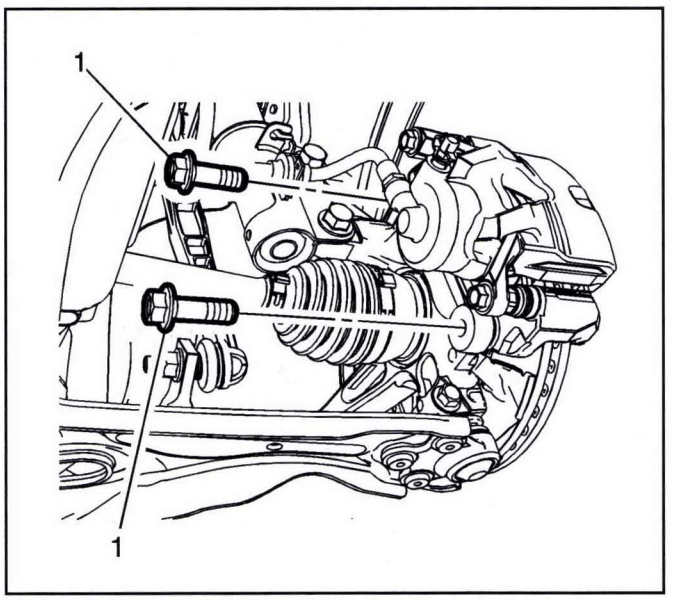
4. Install the brake rotor (1), aligning the brake rotor bolt hole with the threaded hole on the hub/axle flange.



2506042

Caution: Refer to *Fastener Caution on page 0-8*.

5. Install the brake rotor bolt (1) and tighten to **4** N•m **(35 lb in)**.
6. Position the brake caliper and bracket assembly over the brake rotor and to the steering knuckle.



2537426

Note: Do not reuse the brake caliper bracket bolts.

7. Install new brake caliper bracket bolts (1) and tighten to **95** N•m **(70 lb ft)**.
8. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
9. Burnish the brake pads and rotors. Refer to *Brake Pad and Rotor Burnishing on page 5-108*.

Rear Brake Rotor Replacement

Special Tools

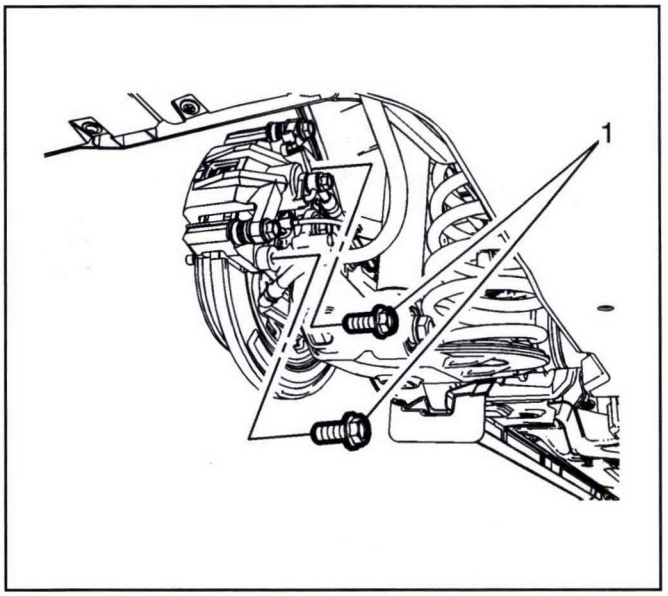
- *CH-41013* Rotor Resurfacing Kit
- *CH-42450-A* Wheel Hub Resurfacing Kit

For equivalent regional tools, refer to *Special Tools on page 5-132*.

Removal Procedure

Warning: Refer to Brake Dust Warning on page 0-4.

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.



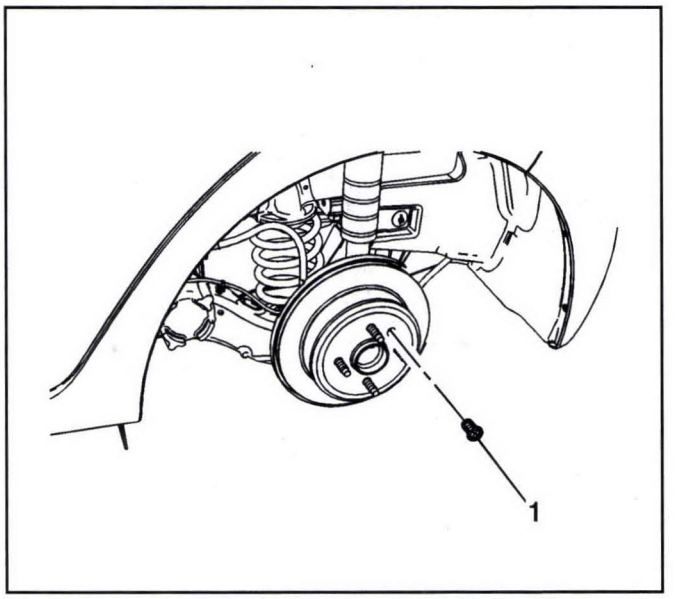
3034107

Note: Do not reuse the brake caliper bracket bolts.

3. Remove and discard the brake caliper bracket bolts (1).

Caution: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

4. Remove the brake caliper and bracket assembly and support with heavy mechanics wire.

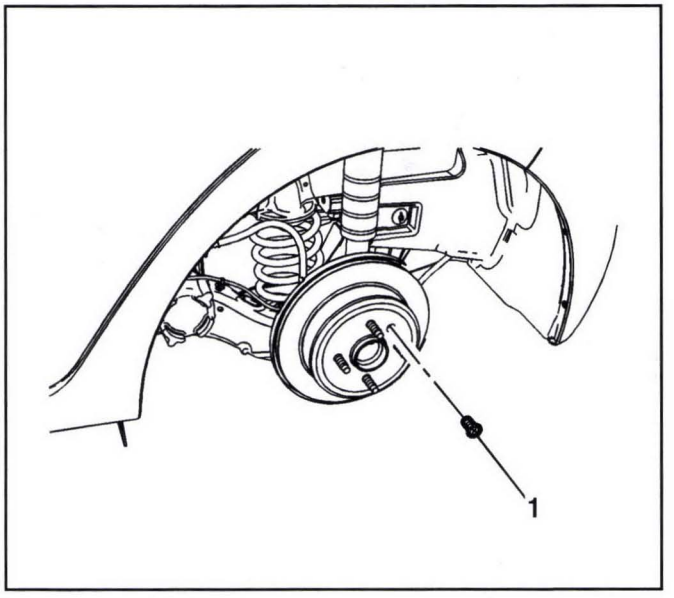


3034109

5. Remove the brake rotor bolt (1).
6. Remove the brake rotor.

Installation Procedure

1. If installing a new brake rotor, clean the friction surfaces of the brake rotor with denatured alcohol or equivalent.
2. Using the *CH-42450-A* Wheel Hub Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange.
3. Using the *CH-41013* Rotor Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the rotor to the hub/axle flange.
4. Install the brake rotor, aligning the brake rotor bolt hole with the threaded hole on the hub/axle flange.

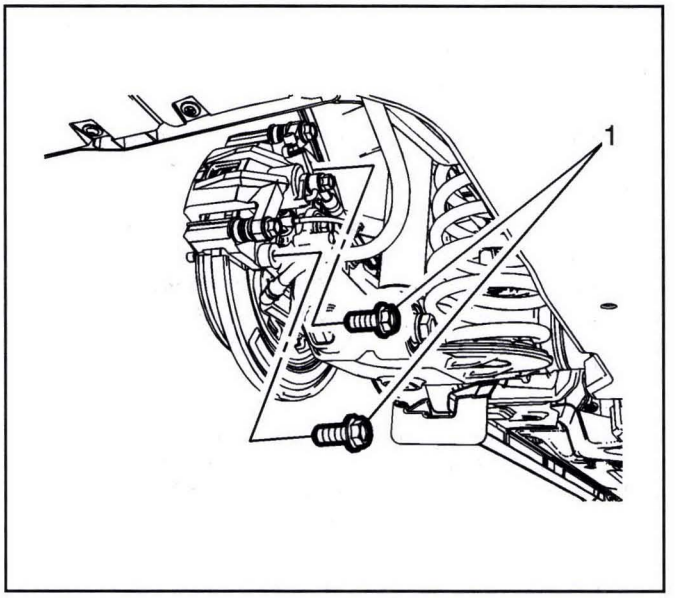


3034109

Caution: Refer to *Fastener Caution on page 0-8*.

5. Install the brake rotor bolt (1) and tighten to **4 N•m (35 lb in)**.

6. Position the brake caliper and bracket assembly over the brake rotor and to the rear axle.



3034107

Note: Do not reuse the brake caliper bracket bolts.

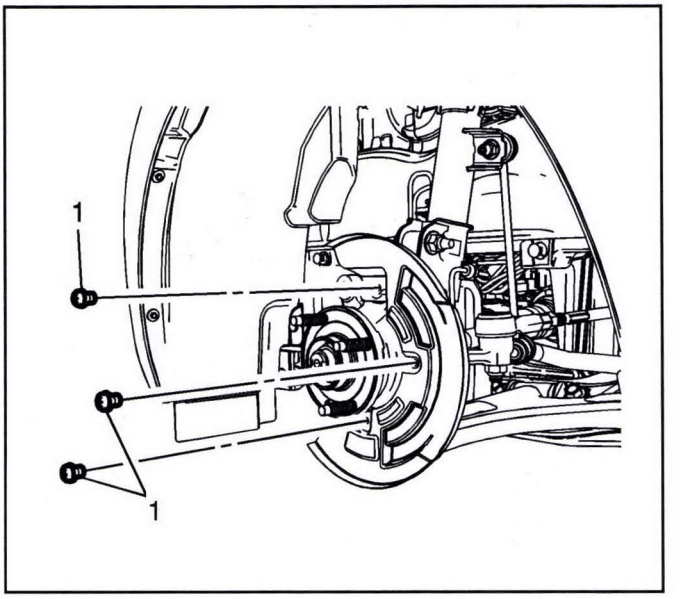
7. Install new brake caliper bracket bolts (1) and tighten to **56** N•m **(41 lb ft)**.
8. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
9. Burnish the brake pads and rotors. Refer to *Brake Pad and Rotor Burnishing on page 5-108*.

Front Brake Shield Replacement

Removal Procedure

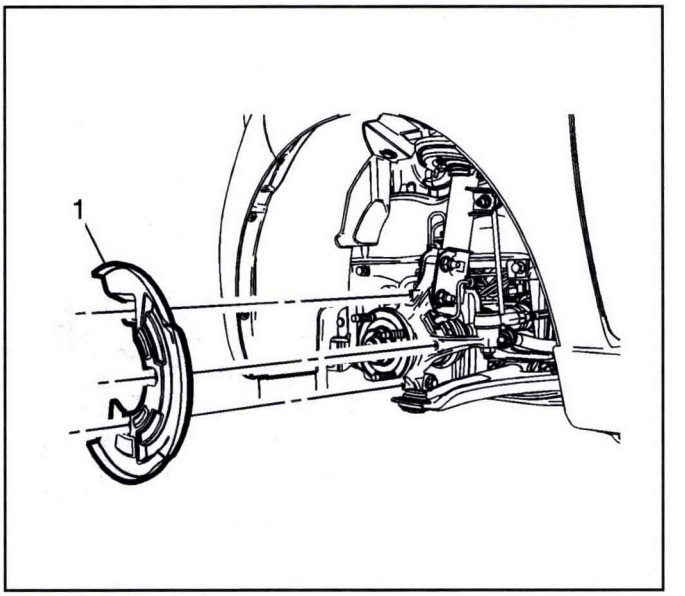
Warning: Refer to Brake Dust Warning on page 0-4.

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
2. Remove the front tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
3. Remove the front brake rotor. Refer to *Front Brake Rotor Replacement on page 5-122*.



3021397

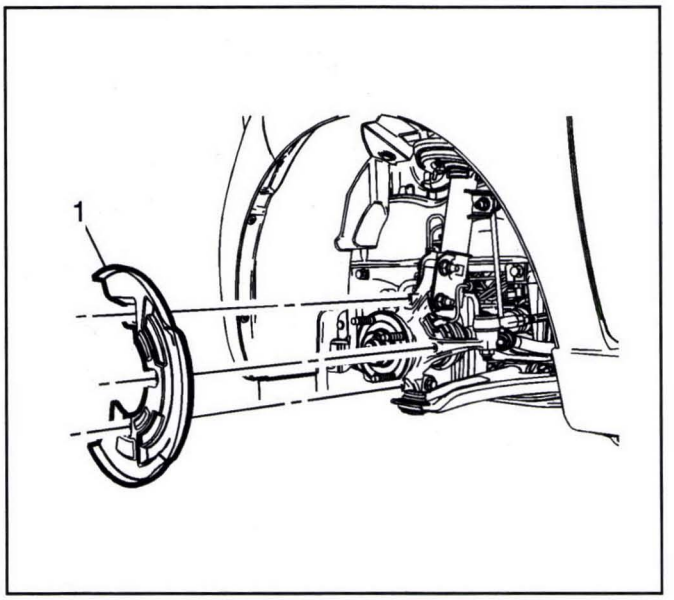
4. Remove the front brake shield bolts (1).



3021400

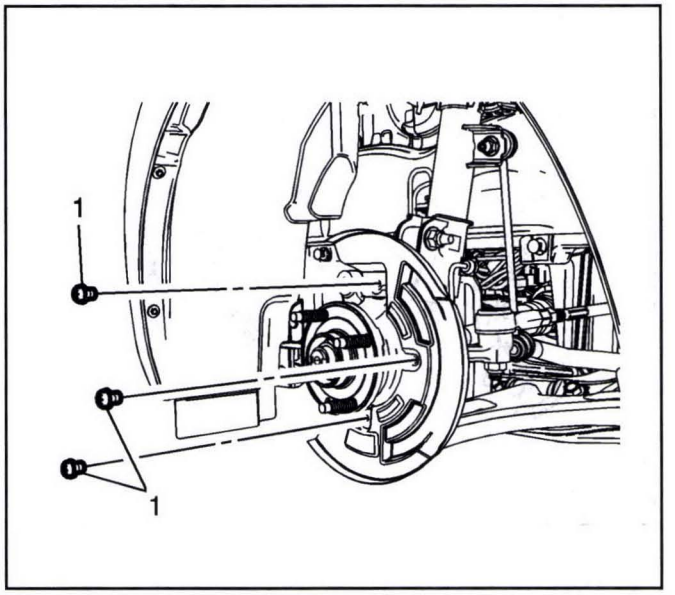
5. Remove the front brake shield (1).

Installation Procedure



3021400

1. Install the front brake shield (1).



3021397

Caution: Refer to *Fastener Caution on page 0-8*.

2. Install the front brake shield bolts (1) and tighten to **4** N•m **(35 lb in)**.
3. Install the front brake rotor. Refer to *Front Brake Rotor Replacement on page 5-122*.
4. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.

Brake Rotor Assembled Lateral Runout Correction

Note:

- Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to *Brake Rotor Thickness Variation Measurement on page 5-97*.
- Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4 800–11 300 km (3,000–7,000 mi). Refer to *Brake Rotor Assembled Lateral Runout Measurement on page 5-98*.

Review the following acceptable methods for bringing the brake rotor assembled LRO to within specifications. Determine which method to use for the specific vehicle being repaired.

- The indexing method of correcting assembled LRO is most effective when the LRO specification is only exceeded by a relatively small amount: 0.025–0.127 mm (0.001–0.005 in). Indexing is used to achieve the best possible match of high spots to low spots between related components. Refer to *Brake Rotor Assembled Lateral Runout Correction - Indexing on page 5-126*.
- The correction plate method of correcting assembled LRO involves the addition of a tapered plate between the brake rotor and the hub/axle flange. The correction plate method can be used to correct LRO that exceeds the specification by up to 0.23 mm (0.009 in). Refer to *Brake Rotor Assembled Lateral Runout Correction - Correction Plates on page 5-128*.
- The on-vehicle brake lathe method is used to bring the LRO to within specifications through compensating for LRO while refinishing the brake rotor. Refer to *Brake Rotor Assembled Lateral Runout Correction - On Vehicle Lathe on page 5-129*.

If the assembled LRO cannot be corrected using these methods, then other components must be suspected as causing and/or contributing to the LRO concern.

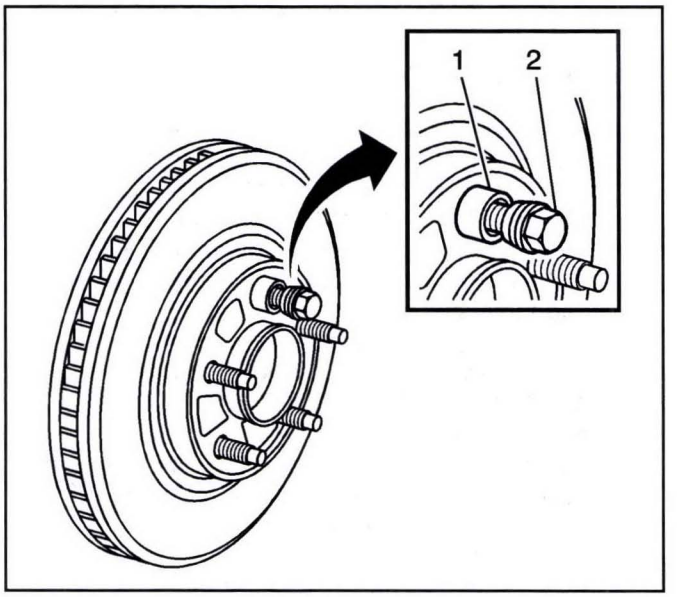
Brake Rotor Assembled Lateral Runout Correction - Indexing

Note: This Procedure is not used in Europe

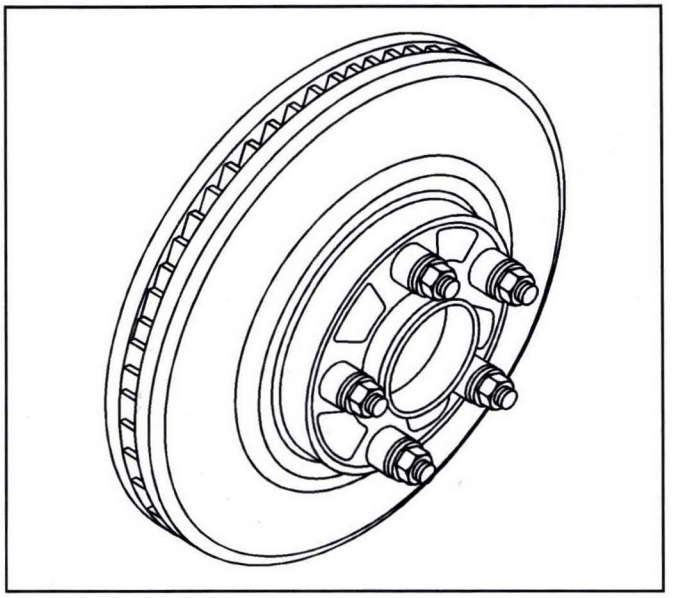
Special Tools

CH-45101-100 Conical Brake Rotor Washers

For equivalent regional tools, refer to *Special Tools on page 5-132*.



891797



891801

Warning: Refer to Brake Dust Warning on page 0-4.

Note:

- Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to *Brake Rotor Thickness Variation Measurement on page 5-97*.
- Brake rotor assembled LRO exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4,800–11, 300 km (3,000–7,000 mi). Refer to *Brake Rotor Assembled Lateral Runout Measurement on page 5-98*.

1. Remove the *CH-45101-100* Conical Brake Rotor Washers and the lug nuts that were installed during the assembled LRO measurement procedure.
2. Inspect the mating surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
3. Index the brake rotor in a different orientation to the hub/axle flange.
4. Hold the rotor firmly in place against the hub/axle flange and install one of the *CH-45101-100* Conical Brake Rotor Washers (1) and one lug nut (2) onto the upper-most wheel stud.
5. Continue to hold the rotor secure and tighten the lug nut firmly by hand.
6. Install the remaining *CH-45101-100* Conical Brake Rotor Washers and lug nuts onto the wheel studs and tighten the nuts firmly by hand in a star-pattern.
7. Tighten the lug nuts in a star-pattern to specification, in order to properly secure the rotor. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
8. Measure the assembled LRO of the brake rotor. Refer to *Brake Rotor Assembled Lateral Runout Measurement on page 5-98*.
9. Compare the amount of change between this measurement and the original measurement.
10. If this measurement is within specifications, proceed to step 14.
11. If this measurement still exceeds specifications, repeat steps 1–9 until the best assembled LRO measurement is obtained.
12. Matchmark the final location of the rotor to the wheel studs if the orientation is different than it was originally.
13. If the brake rotor assembled LRO measurement still exceeds the maximum allowable specification, refer to *Brake Rotor Assembled Lateral Runout Correction on page 5-126*.
14. If the brake rotor assembled LRO is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the *CH-45101-100* Conical Brake Rotor Washers and the lug nuts.

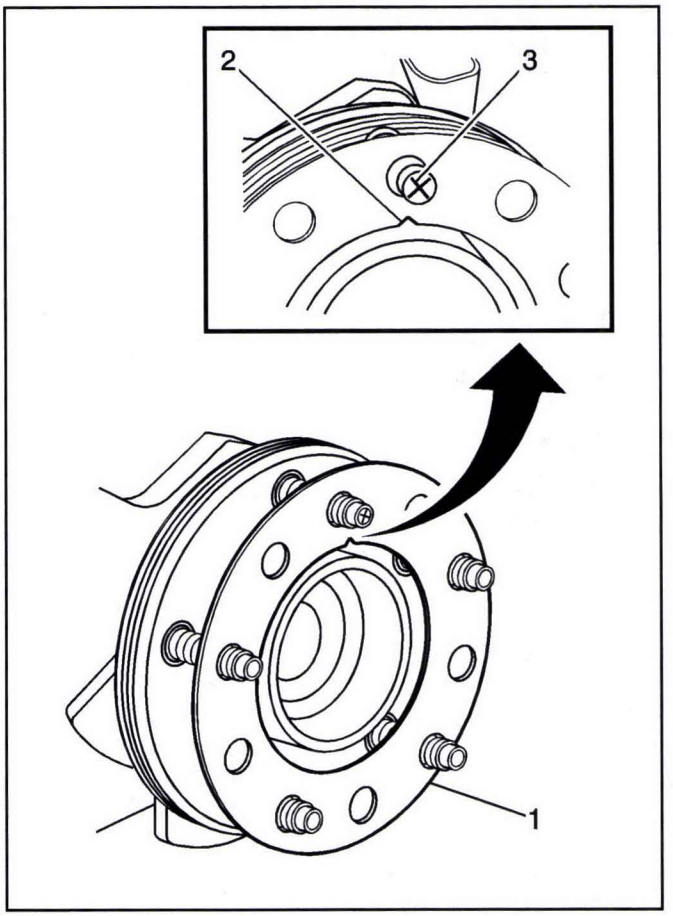
Brake Rotor Assembled Lateral Runout Correction - Correction Plates

Note: This procedure not used in Europe

Special Tools

CH-45101-100 Conical Brake Rotor Washers

For equivalent regional tools, refer to *Special Tools on page 5-132*.



891804

Warning: Refer to Brake Dust Warning on page 0-4.

Note:

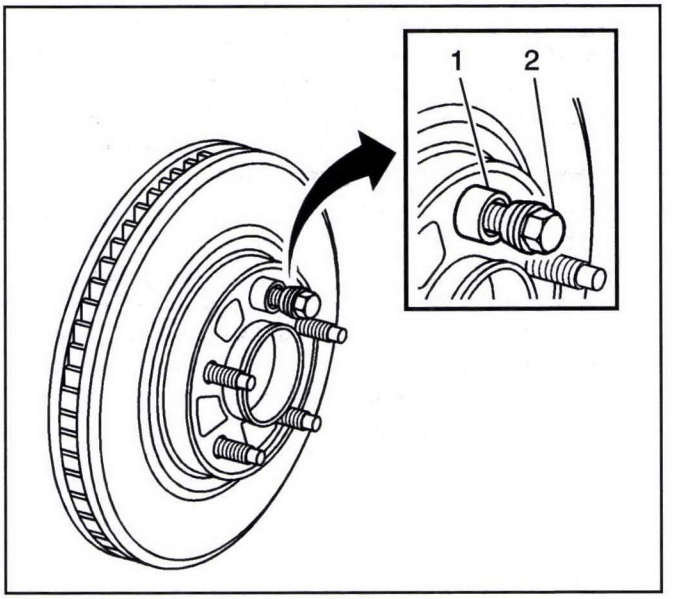
- Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to *Brake Rotor Thickness Variation Measurement on page 5-97*.
- Brake rotor assembled LRO exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4,800–11,300 km (3,000–7,000 mi). Refer to *Brake Rotor Assembled Lateral Runout Measurement on page 5-98*.

1. Rotate the brake rotor to position the high spot, identified and marked during the brake rotor assembled LRO measurement procedure, to face upward.
2. Remove the *CH-45101-100* Conical Brake Rotor Washers and the lug nuts that were installed during the assembled LRO measurement procedure and/or the indexing correction procedure.
3. Inspect the mounting surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
4. Select the correction plate, following the manufacturer's instructions, which has a specification closest to the assembled LRO measurement.

   For example: If the assembled LRO measurement was 0.076 mm (0.003 in), the 0.076 mm (0.003 in) correction plate would be used. If the measurement was 0.127 mm (0.005 in), the 0.152 mm (0.006 in) correction plate would be used.
5. Determine the positioning for the correction plate (1) using the high spot mark (3) made during the brake rotor assembled LRO measurement procedure.

   Note:

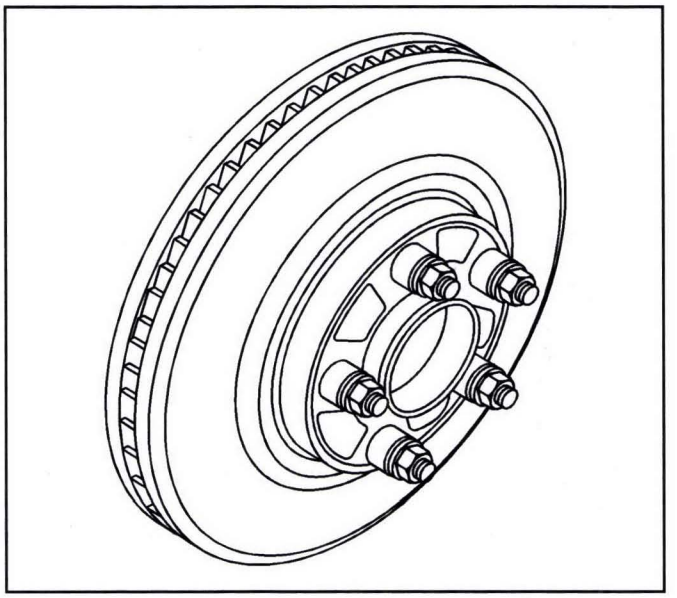
   - Do NOT install used correction plates in an attempt to correct brake rotor assembled LRO.
   - Do NOT stack up, or install more than one correction plate onto one hub/axle flange location, in an attempt to correct brake rotor assembled LRO.
6. Install the correction plate (1) onto the hub/axle flange, with the V-shaped notch (2) orientated to align with the high spot mark (3), that was positioned to face upward.



891797

7. Install the brake rotor to the hub/axle flange. Use the matchmark made prior to removal for proper orientation to the flange.

8. Hold the rotor firmly in place against the hub/axle flange and install one of the *CH-45101-100* Conical Brake Rotor Washers (1) and one lug nut (2) onto the upper-most wheel stud.
9. Continue to hold the rotor secure and tighten the lug nut firmly by hand.



891801

10. Install the remaining *CH-45101-100* Conical Brake Rotor Washers and lug nuts onto the wheel studs and tighten the nuts firmly by hand in a star-pattern.
11. Tighten the lug nuts in a star-pattern to specification, in order to properly secure the rotor. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
12. Measure the assembled LRO of the brake rotor. Refer to *Brake Rotor Assembled Lateral Runout Measurement on page 5-98*.
13. If the brake rotor assembled LRO measurement still exceeds the maximum allowable specification, refer to *Brake Rotor Assembled Lateral Runout Correction on page 5-126*.
14. If the brake rotor assembled LRO measurement is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the *CH-45101-100* Conical Brake Rotor Washers and the lug nuts.

Brake Rotor Assembled Lateral Runout Correction - On Vehicle Lathe

Note: This procedure is not used in Europe.

Special Tools

CH-45101-100 Conical Brake Rotor Washers

For equivalent regional tools, refer to *Special Tools on page 5-132*.

Warning: Refer to Brake Dust Warning on page 0-4.

Note:

- Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to *Brake Rotor Thickness Variation Measurement on page 5-97*.
- Brake rotor assembled LRO exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4 800–11 300 km (3,000–7,000 mi). Refer to *Brake Rotor Assembled Lateral Runout Measurement on page 5-98*.

1. Ensure that the caliper and caliper bracket that are already being supported, are clear from contacting any rotating components, such as the brake rotor.
2. Remove the *CH-45101-100* Conical Brake Rotor Washers and the lug nuts that were installed during the assembled LRO measurement procedure and/or the indexing correction procedure.
3. Inspect the mounting surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
4. Set up the lathe, following the manufacturer's instructions.
5. Refinish the brake rotor, following the brake lathe manufacturer's instructions.
6. After each successive cut, inspect the brake rotor thickness. Refer to *Brake Rotor Thickness Measurement on page 5-97*.
7. If at any time the brake rotor exceeds the minimum allowable thickness after refinish specification, the brake rotor must be replaced. After replacing the rotor, proceed to step 10.
8. After refinishing the brake rotor, use the following procedure in order to obtain the desired non-directional finish:
   8.1. Follow the brake lathe manufacturer's recommended speed setting for applying a non-directional finish.
   8.2. Using moderate pressure, apply the non-directional finish:
      - If the lathe is equipped with a non-directional finishing tool, apply the finish with 120-grit aluminum oxide sandpaper.
      - If the lathe is not equipped with a non-directional finishing tool, apply the finish with a sanding block and 150-grit aluminum oxide sandpaper.
   8.3. After applying a non-directional finish, clean each friction surface of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.
9. Remove the lathe from the vehicle.
10. Measure the assembled LRO of the brake rotor. Refer to *Brake Rotor Assembled Lateral Runout Measurement on page 5-98*.

11. If the brake rotor assembled LRO measurement still exceeds the maximum allowable specification, refer to *Brake Rotor Assembled Lateral Runout Correction on page 5-126*.
12. If the brake rotor assembled LRO is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the *CH-45101-100* Conical Brake Rotor Washers and the lug nuts.

Brake Rotor Refinishing

Special Tools

- *CH-41013* Rotor Resurfacing Kit
- *CH-42450-A* Wheel Hub Resurfacing Kit

For equivalent regional tools, refer to *Special Tools on page 5-132*.

Warning: Refer to Brake Dust Warning on page 0-4.

Note:

- The disc brake rotors do not require refinishing as part of routine brake system service. New disc brake rotors do not require refinishing.

  Do not refinish disc brake rotors in an attempt to correct the following conditions:

  – Brake system noise – squeal, growl, groan
  – Uneven and/or premature disc brake pad wear
  – Superficial or cosmetic corrosion/rust of the disc brake rotor friction surface
  – Scoring of the disc brake rotor friction surface less than the maximum allowable specification
- Before refinishing a brake rotor, the rotor MUST first be checked for adequate thickness to allow the rotor to be refinished and remain above the minimum allowable thickness after refinish specification. Refer to *Brake Rotor Thickness Measurement on page 5-97*.

  Disc brake rotors should only be refinished if they have adequate thickness to be refinished and if one or more of the following conditions exist:

  – Thickness variation in excess of the maximum allowable specification
  – Excessive corrosion/rust and/or pitting
  – Cracks and/or heat spots
  – Excessive blueing discoloration
  – Scoring of the disc brake rotor surface in excess of the maximum allowable specification
- Disc brake rotors may need to be refinished as part of the process for correcting brake rotor assembled lateral runout (LRO) that exceeds the maximum allowable specification.

Note: If the vehicle is equipped with cross-drilled rotors, use a lathe with positive rake tooling. This setup requires less cutting pressure, which will result in less vibration, and a better surface finish. Also, use a vibration dampener when cutting. Otherwise, refinish according to the following instructions.

Note: Whenever the brake rotor has been separated from the hub/axle flange, clean any rust or contaminants from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in increased assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.

1. Using the *CH-42450-A* Wheel Hub Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange.
2. Using the *CH-41013* Rotor Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface and mounting surface of the brake rotor.
3. Inspect the mating surfaces of the hub/axle flange and the rotor to ensure that there are no foreign particles or debris remaining.
4. Mount the brake rotor to the brake lathe according to the lathe manufacturer's instructions, ensuring that all mounting attachments and adapters are clean and free of debris.
5. Ensure that any vibration dampening attachments are securely in place.
6. With the brake lathe running, slowly bring in the cutting tools until they just contact the brake rotor friction surfaces.
7. Observe the witness mark on the brake rotor. If the witness mark extends approximately three-quarters or more of the way around the brake rotor friction surface on each side, the brake rotor is properly mounted to the lathe.
8. If the witness mark does not extend three-quarters or more of the way around the brake rotor, re-mount the rotor to the lathe.
9. Following the brake lathe manufacturer's instructions, refinish the brake rotor.
10. After each successive cut, inspect the brake rotor thickness. Refer to *Brake Rotor Thickness Measurement on page 5-97*.
11. If at any time the brake rotor exceeds the minimum allowable thickness after refinish specification, the brake rotor must be replaced.
12. After refinishing the brake rotor, use the following procedure in order to obtain the desired non-directional finish:

    12.1. Follow the brake lathe manufacturer's recommended speed setting for applying a non-directional finish.

    12.2. Using moderate pressure, apply the non-directional finish:

    - If the lathe is equipped with a non-directional finishing tool, apply the finish with 120-grit aluminum oxide sandpaper.
    - If the lathe is not equipped with a non-directional finishing tool, apply the finish with a sanding block and 150-grit aluminum oxide sandpaper.

    Note: Thoroughly cleaning the brake rotor will prevent the possible transfer of finite metal dust left as a by-product of machining to

the brake pad material during the burnishing process, thereby reducing the possibility for brake squeal or other brake noises to occur.

12.3. After applying a non-directional finish, clean each friction surface of the brake rotor with a solution of mild dish washing detergent and water, or a GM approved brake cleaner and a clean shop towel to remove metal particles remaining from machining. Repeat the cleaning process if necessary to remove all metal particles.

13. Remove the brake rotor from the brake lathe.
14. Measure the assembled LRO of the brake rotor to ensure optimum performance of the disc brakes. Refer to *Brake Rotor Assembled Lateral Runout Measurement on page 5-98*.
15. If the brake rotor assembled LRO measurement exceeds the specification, bring the LRO to within specifications. Refer to *Brake Rotor Assembled Lateral Runout Correction on page 5-126*.

Description and Operation

Disc Brake System Description and Operation

System Component Description

The disc brake system consists of the following components:

Disc Brake Pads: Applies mechanical output force from the hydraulic brake calipers to friction surfaces of brake rotors.

Disc Brake Rotors: Uses mechanical output force applied to friction surfaces from the disc brake pads to slow speed of tire and wheel assembly rotation.

Disc Brake Pad Hardware: Secures disc brake pads firmly in proper relationship to the hydraulic brake calipers. Enables a sliding motion of brake pads when mechanical output force is applied.

Disc Brake Caliper Hardware (Floating Caliper): Provides mounting for hydraulic brake caliper and secures the caliper firmly in proper relationship to caliper bracket. Enables a sliding motion of the brake caliper to the brake pads when mechanical output force is applied.

System Operation (Floating Caliper)

Mechanical output force is applied from the hydraulic brake caliper pistons to the inner brake pads. As the pistons press the inner brake pads outward, the caliper housings draw the outer brake pads inward. This allows the output force to be equally distributed. The brake pads apply the output force to the friction surfaces on both sides of the brake rotors, which slows the rotation of the tire and wheel assemblies. The correct function of both the brake pad and brake caliper hardware is essential for even distribution of braking force.

System Operation (Fixed Caliper)

Mechanical output force is applied from the hydraulic brake caliper inboard and outboard pistons to the inner and outer brake pads. The brake calipers are a fixed, opposed-piston design, allowing the output force to be equally distributed through the distribution of the pressurized brake fluid within the caliper. The brake pads apply the output force to the friction surfaces on both sides of the brake rotors, which slows the rotation of the tire and wheel assemblies. The correct function of the brake pad hardware and of the brake caliper inboard and outboard pistons is essential for even distribution of braking force.

System Characteristics

Brake Noise

Brake noise can occur and to a degree, some brake noise is normal. Variations in driving conditions such as the weather, environment, driving patterns, differences in vehicle loading, and type or style of driving, can affect brake wear. Any one of these variations can cause brake noise to become apparent. Inspect and verify that all metal-to-metal contact areas of the brake pads, brake pad guides or springs, brake caliper housing, caliper bracket and/or suspension knuckle, as applicable, are clean and free of corrosion and scale.

Brake noise is a "slip-stick" vibration of disc brake components and, if it occurs intermittently, can be considered normal. Most brake noise may be eliminated or temporarily reduced by performing 3 or 4 aggressive brake applications. If the brake noise persists or consistently recurs, application of a damping compound to the brake pad mounting plate where it contacts the caliper can lessen the vibration as the components move relative to each other. Refer to Adhesives, Fluids, Lubricants, and Sealers in this section for recommended compounds.

The following brake noises are characteristic of all brake systems. These noises cannot be avoided, and may not indicate improper operation of the brake system.

Squeak/Squeal Noise

A squeak or squeal noise can occur on vehicles with front semi-mettalic brake pads during light to medium brake pedal application at low to moderate vehicle speeds. Occasionally this noise may appear from the front or rear brakes after a period of non-use such as overnight, or cold brakes and/or in high humidity conditions.

Grinding Noise

Common occurrence for rear brakes and some front disc brakes during initial brake applications after the vehicle has been parked overnight. Caused by light corrosion forming on the metal brake component friction surfaces during vehicle non-use. Typically disappears after the first few brake applications.

Groan Noise

A groan type noise may be heard during a quick stop, or when slowly moving forward from a complete stop. On vehicles equipped with antilock brake systems (ABS), a groan or moan noise may occur during heavy brake application or on road surfaces with compromised traction such as loose gravel, or on wet or icy roads. This is a normal function of ABS activation.

Special Tools and Equipment

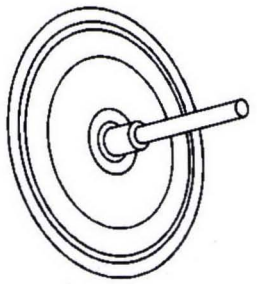
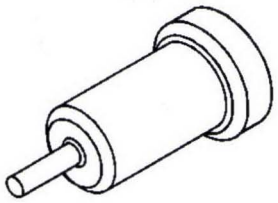
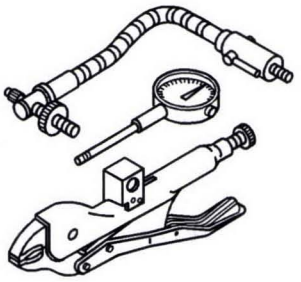
Illustration	Tool Number/ Description
 573333	CH 41013 J 41013 Rotor Resurfacing Kit
 380097	CH 42450-A J 42450-A Wheel Hub Resurfacing Kit

Illustration	Tool Number/ Description
 891822	CH 45101 J 45101 Hub and Wheel Runout Gauge
891825	CH 45101-100 J 45101-100 Conical Brake Rotor Washers

Hydraulic Brakes

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Brake Hose Bracket Bolt	9 N•m	80 lb in
Brake Hose Fitting Bolt- Front and Rear	40 N•m	30 lb ft
Brake and Accelerator Pedal Assembly Nut	22 N•m	16 lb ft
Brake Pipe Fitting	18 N•m	13 lb ft
Drive Motor Power Inverter Module Cable Fastener	9 N•m	80 lb in
Master Cylinder Nut	25 N•m	18 lb ft
Master Cylinder Reservoir Bolt	8 N•m	71 lb in

Approximate Fluid Capacities

Application	Specification	
	Metric	English
Hydraulic Brake System	0.5 L	1.567 pt

Brake Component Specifications

Application	Specification	
	Metric	English
Brake Caliper Bleeder	10 N•m	89 lb in

Brake System Specifications

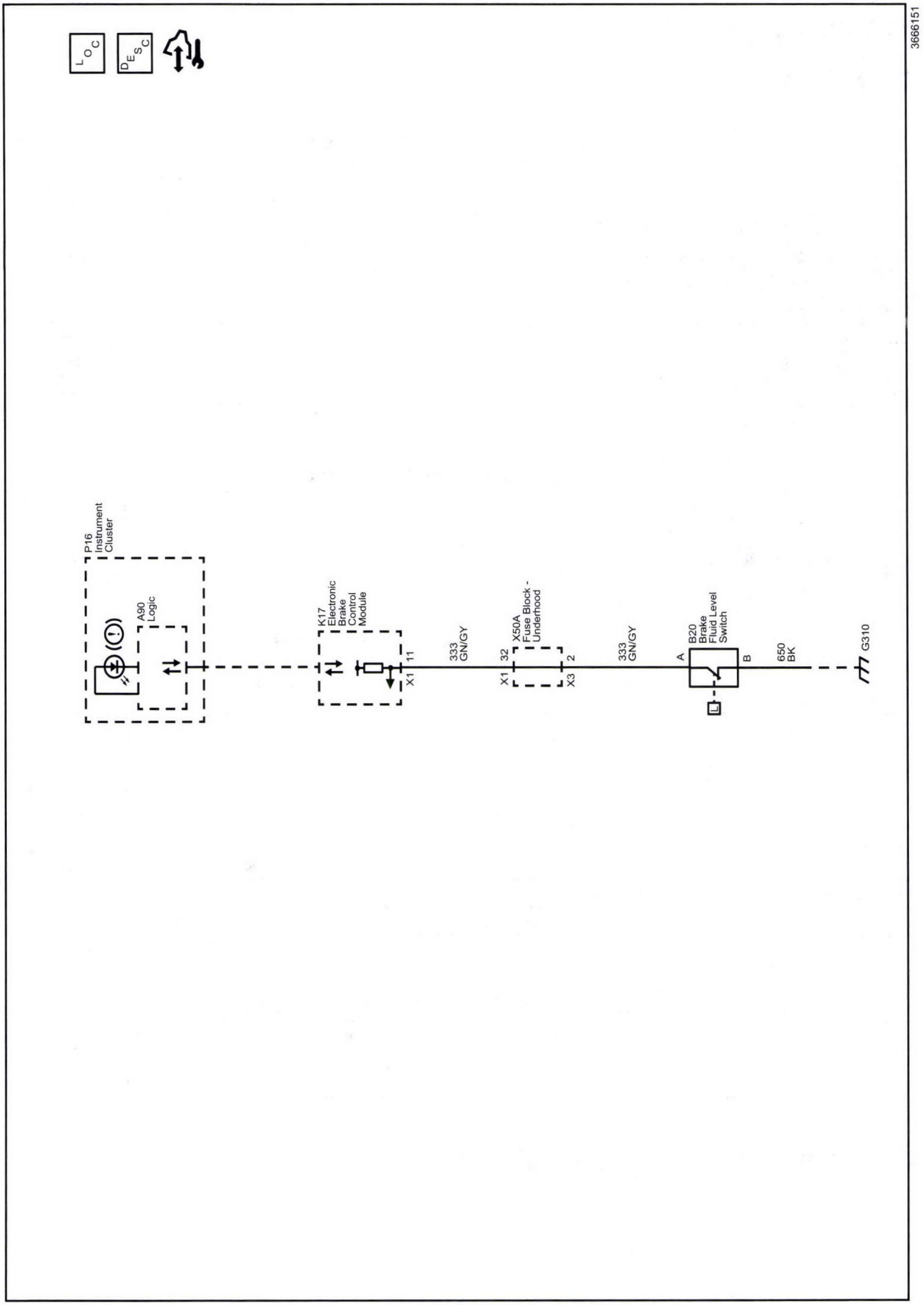
Application	Specification	
	Metric	English
Maximum Brake Master Cylinder (BMC) Primary Piston Travel*	18 mm	0.71 in
*Measured at a brake pedal apply force (with the power button ON and the brake cool) of 5000 kPa (725 psi).		

Adhesives, Fluids, Lubricants, and Sealers

Application	Type of Material	GM Part Number
Hydraulic Brake System	DOT 4 Motor Vehicle Brake Fluid	19299570 (Canada 19299571)

Schematic and Routing Diagrams

Hydraulic Brake Schematics (Hydraulic Brakes)



Diagnostic Information and Procedures

DTC C0267

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptor

DTC C0267: Low Brake Fluid Indicated

For symptom byte information refer to *Symptom Byte List on page 6-117*.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	C0267 00	C0267 05	C0267 05	—
Ground	—	C0267 05	—	—

Circuit/System Description

The instrument cluster turns ON the brake warning indicator for 5 s after vehicle ON. When the electronic brake control module detects a fault, it sends a serial data message to the instrument cluster commanding the brake warning indicator ON.

Conditions for Running the DTC

Vehicle in Service Mode.

Conditions for Setting the DTC

- An open is detected on the brake fluid level signal circuit for 20 s.
- Low brake fluid level is detected for 20 s.

Action Taken When the DTC Sets

- The electronic brake control module disables the traction control and stability control for the duration of the ignition cycle.
- The traction control/stability control-active indicator turns ON.
- The brake warning indicator turns ON.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Hydraulic Brake Schematics on page 5-134

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Hydraulic Brake System Description and Operation on page 5-218

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Verify that the brake fluid has the proper level. The fluid level should be above minimum level.

⇒ **If low**

Refer to *Brake Fluid Loss on page 5-148*.

⇓ **If above minimum level**

2. Vehicle in Service Mode.
3. Verify the brake warning indicator turns ON and OFF, when commanding the instrument cluster All Indicators ON and OFF with a scan tool.

⇒ **If the brake warning indicator does not turn ON and OFF**

Replace the P16 Instrument Cluster.

⇓ **If the brake warning indicator turns ON and OFF**

4. Refer to Circuit/System Testing.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the B20 Brake Fluid Level Switch.
2. Test for less than 10 Ω between the ground circuit terminal B and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇒ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Electronic Brake Control Module, Brake Fluid Level Sensor parameter is Low.

⇒ **If the parameter is Low**

4.1. Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.

4.2. Test for infinite resistance between the signal circuit terminal A and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K17 Electronic Brake Control Module.

⇓ **If the parameter is not Low**

5. Install a 3 A fused jumper wire between the signal circuit terminal A and ground.
6. Verify the scan tool Electronic Brake Control Module, Brake Fluid Level Sensor parameter is Ok.

⇒ **If the parameter is OK**

6.1. Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, Vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V.

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K17 Electronic Brake Control Module.

⇓ **If the parameter is not Ok**

7. Test or replace the B20 Brake Fluid Level Switch.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Brake Fluid Level Indicator Switch Replacement on page 5-173*
- *Control Module References on page 6-3* for Electronic Brake Control Module replacement, programming and setup

Symptoms - Hydraulic Brakes

Important: The following steps must be completed before using the symptom tables.

1. Perform the *Brake System Vehicle Road Test on page 5-161* before using the hydraulic brake symptom tables in order to duplicate the customer's concern.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to the following:
   - *Hydraulic Brake System Description and Operation on page 5-218*
   - *Brake System, Hydraulic, Assist, and Control Description and Operation on page 5-215*
   - *Hydraulic Brake Component Operation Visual Inspection on page 5-163*

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Hydraulic Brake System. Refer to *Checking Aftermarket Accessories on page 11-871*.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to *Testing for Intermittent Conditions and Poor Connections on page 11-877*.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- *Brake Pulsation on page 5-138*
- *Brake System Noise on page 5-139*
- *Braking Action Uneven - Pulls to One Side on page 5-140*
- *Braking Action Uneven - Front to Rear on page 5-142*
- *Brake Pedal Excessive Travel on page 5-143*
- *Brake Pedal Excessive Effort on page 5-144*
- *Brakes Drag on page 5-145*
- *Brake System Slow Release on page 5-147*
- *Brake Fluid Loss on page 5-148*
- *Brake Hydraulic and Assist System Diagnosis on page 5-153*

Brake Warning Indicator Malfunction

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Fluid Level Signal	C0267 00	C0267 05	C0267 05	—
Ground	—	C0267 05	—	—

Circuit/System Description

The instrument cluster turns ON the brake warning indicator for 5 s after vehicle ON. When the electronic brake control module detects a fault, it sends a serial data message to the instrument cluster commanding the brake warning indicator ON.

Reference Information

Schematic Reference

Hydraulic Brake Schematics on page 5-134

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Brake Warning System Description and Operation on page 5-218

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Verify that the brake fluid has the proper level. The fluid level should be above minimum level.

⇒ **If low**

Refer to *Brake Fluid Loss on page 5-148*.

⇓ **If above minimum level**

2. Vehicle in Service Mode.
3. Verify the brake warning indicator turns ON and OFF, when commanding the instrument cluster All Indicators ON and OFF with a scan tool.

⇒ **If the brake warning indicator does not turn ON and OFF**

Replace the P16 Instrument Cluster.

⇓ **If the brake warning indicator turns ON and OFF**

4. Refer to Circuit/System Testing.

Circuit/System Testing

Note: Circuit/System Verification must be performed before Circuit/System Testing.

1. Vehicle OFF, disconnect the harness connector at the B20 Brake Fluid Level Switch.
2. Test for less than 10 Ω between the ground circuit terminal B and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Electronic Brake Control Module, Brake Fluid Level Sensor parameter is Low.

⇒ **If the parameter is Low**

4.1. Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.

4.2. Test for infinite resistance between the signal circuit terminal A and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K17 Electronic Brake Control Module.

⇓ **If the parameter is not Low**

5. Install a 3 A fused jumper wire between the signal circuit terminal A and ground.
6. Verify the scan tool Electronic Brake Control Module, Brake Fluid Level Sensor parameter is Ok.

⇒ **If the parameter is OK**

6.1. Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, Vehicle in Service Mode.

6.2. Test for less than 1 V between the signal circuit and ground.

⇒ If 1 V or greater, repair the short to voltage on the circuit.

⇓ If less than 1 V.

6.3. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K17 Electronic Brake Control Module.

⇓ **If the parameter is not Ok**

7. Test or replace the B20 Brake Fluid Level Switch.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Brake Fluid Level Indicator Switch Replacement on page 5-173*
- *Control Module References on page 6-3* for Control Module replacement, programming and setup.

Brake Pulsation

Step	Action	Yes	No
DEFINITION: • Fluctuation or pulsation is felt through the brake pedal, steering wheel, seat, floor, and/or in the vehicle ONLY when braking. • Notchy or uneven brake pedal feel during brake apply. • Kickback is felt through the brake pedal during brake apply and release.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to *Step 2*	Go to *Symptoms - Hydraulic Brakes on page 5-136*
2	1. Inspect the disc brake system for the following conditions: • Excessive thickness variation of rotor friction surfaces • Excessive assembled lateral runout (LRO) of rotor friction surfaces • Hard spots, heat checks, bluing discoloration of rotor friction surfaces; possibly due to brake drag • Excessive corrosion of rotor friction surfaces; including red, gray or black oxidation • Loose, damaged or missing caliper or lining hardware • Bent or damaged caliper or mounting component • Excessive LRO of wheel hub/axle flange; due to damage and/or loose or excessively worn bearings 2. Perform the disc brake system diagnostic procedure. Refer to *Disc Brake System Diagnosis on page 5-148*. 3. Adjust, repair or replace components as necessary. Did you find and correct a condition?	Go to *Step 8*	Go to *Step 3*

Brake Pulsation (cont'd)

Step	Action	Yes	No
3	1. Inspect the brake hydraulic and assist systems for the following conditions: • Lack of lubrication, binding, excessively worn and/or damaged brake pedal pushrod, pin and/or pedal pivot bushings. • Bent or damaged pedal pushrod, pedal, or pedal bracket. • Restricted brake master cylinder reservoir-to-brake pressure modulator valve (BPMV) feed and/or return hoses. 2. Perform the entire brake and hydraulic assist system diagnostic procedure. Refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*. 3. Adjust, repair or replace components as necessary. Did you find and correct a condition?	Go to *Step 8*	Go to *Step 4*
4	Does the brake pedal feel notchy or uneven during brake apply?	Go to *Step 6*	Go to *Step 5*
5	Is kickback felt through the brake pedal during brake apply and release?	Go to *Step 7*	Go to *Symptoms - Hydraulic Brakes on page 5-136*
6	1. Replace the brake master cylinder for sticking or improperly functioning pistons. Refer to *Master Cylinder Replacement on page 5-168*. 2. Pressure bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*. 3. Perform the entire *Antilock Brake System Automated Bleed on page 5-72*. Did you find and correct a condition?	Go to *Step 8*	Go to *Symptoms - Hydraulic Brakes on page 5-136*
7	1. Replace the brake pressure modulator valve (BPMV) for an improperly functioning boost circuit. Refer to *Brake Pressure Modulator Valve Replacement on page 5-76*. 2. Pressure bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*. 3. Perform the entire *Antilock Brake System Automated Bleed on page 5-72*. Did you find and correct a condition?	Go to *Step 8*	Go to *Symptoms - Hydraulic Brakes on page 5-136*
8	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to *Brake System Vehicle Road Test on page 5-161*. Is the condition still present?	Go to *Step 2*	System OK

Brake System Noise

Step	Action	Yes	No
DEFINITION: Vehicle exhibits abnormal noise when braking; vehicle may exhibit abnormal noise during motion just after brake pedal release.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to *Step 2*	Go to *Diagnostic Starting Point - Vehicle on page 6-90*

Brake System Noise (cont'd)

Step	Action	Yes	No
2	1. Inspect the disc brake system for the following conditions. • Lining wear indicator contact with rotor • Debris trapped between rotor and splash shield or backing plate; and/or debris trapped between rotor and linings • Contaminated linings • Aftermarket linings • Glazed linings • Distorted, cracked or damaged linings • Excessively worn linings • Damaged or excessively worn caliper hardware and/or lining hardware • Incorrectly installed, loose or missing caliper hardware and/or lining hardware • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Bent or damaged splash shield or backing plate • Hard spots, heat checks, blueing discoloration of rotor friction surfaces • Glazed rotor friction surfaces • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to *Disc Brake System Diagnosis on page 5-148*. Did you find and correct a condition?	Go to *Step 6*	Go to *Step 3*
3	1. Inspect the brake apply system for the following conditions. • Lack of lubrication or excessively worn pushrod or pedal pivots or pivot bushings • Bent or damaged pedal pushrod, pedal, or pedal bracket 2. Adjust, repair or replace components as necessary. Refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*. Did you find and correct a condition?	Go to *Step 6*	Go to *Step 4*
4	1. Inspect the hydraulic brake system for the following conditions. • Improper operation of caliper pistons • Contaminated brake fluid 2. Adjust, repair or replace components as necessary. Refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*. Did you find and correct a condition?	Go to *Step 6*	Go to *Step 5*
5	Inspect the park brake system for proper operation. Refer to *Park Brake System Diagnosis on page 5-245*. Did you find and correct a condition?	Go to *Step 6*	Go to *Diagnostic Starting Point - Vehicle on page 6-90*
6	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to *Brake System Vehicle Road Test on page 5-161*. Is the condition still present?	Go to *Step 2*	System OK

Braking Action Uneven - Pulls to One Side

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4. Suspension components that are not operating properly may cause a disturbance to the vehicle during application of the brake system.
5. Steering components that are not operating properly may cause a disturbance to the vehicle during application of the brake system.

Braking Action Uneven - Pulls to One Side

Step	Action	Yes	No
DEFINITION: Vehicle pulls to one side only when braking.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to *Step 2*	Go to *Symptoms - Hydraulic Brakes on page 5-136*
2	1. Inspect the brake hydraulic and assist systems for the following conditions: • Kinked, pinched or damaged brake pipe or flexible brake hose • Sticking or improperly operating caliper piston • Brake fluid leak 2. Perform the entire brake and hydraulic assist system diagnostic procedure. Refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*. 3. Adjust, repair or replace components as necessary. Did you find and correct a condition?	Go to *Step 7*	Go to *Step 3*
3	1. Inspect the disc brake system for the following conditions. • Contaminated linings • Glazed linings • Distorted, cracked or damaged linings on one side • Loose, damaged or missing caliper hardware and/or lining hardware • Incorrect linings on one side • Hard spots, heat checks, blueing discoloration of rotor friction surfaces; possibly due to brake drag • Glazed rotor friction surfaces • Bent or damaged caliper or mounting component 2. Perform the disc brake system diagnostic procedure. Refer to *Disc Brake System Diagnosis on page 5-148*. 3. Adjust, repair or replace components as necessary. Did you find and correct a condition?	Go to *Step 7*	Go to *Step 4*
4	1. Inspect the suspension system for the following conditions. • Incorrect tire pressures • Loose suspension component connections • Excessively worn or damaged suspension components 2. Adjust, repair or replace components as necessary. Refer to *Symptoms - Suspension General Diagnosis on page 15-28*. Did you find and correct a condition?	Go to *Step 7*	Go to *Step 5*
5	1. Inspect the steering system for the following conditions. • Loose steering component connections • Excessively worn or damaged steering components 2. Adjust, repair or replace components as necessary. Refer to *Symptoms - Power Steering System on page 14-9*. Did you find and correct a condition?	Go to *Step 7*	Go to *Step 6*
6	1. Replace the brake master cylinder for an improperly functioning secondary circuit. Refer to *Master Cylinder Replacement on page 5-168*. 2. Pressure bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*. 3. Perform the entire *Antilock Brake System Automated Bleed on page 5-72*. Did you find and correct a condition?	Go to *Step 7*	Go to *Symptoms - Hydraulic Brakes on page 5-136*
7	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to *Brake System Vehicle Road Test on page 5-161*. Is the condition still present?	Go to *Step 2*	System OK

Braking Action Uneven - Front to Rear

Test Descriptions

The number below refers to the step number on the diagnostic table.

4. Suspension components that are not operating properly may cause a disturbance to the vehicle during application of the brake system.

Braking Action Uneven - Front to Rear

Step	Action	Yes	No
DEFINITION: Braking action or stopping force sensitive or grabbing and/or more pronounced at the front or at the rear axle. Sensitive or grabbing brakes: Excessive brake jump-in force relative to brake pedal input.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to *Step 2*	Go to *Diagnostic Starting Point - Vehicle on page 6-90*
2	1. Inspect the hydraulic brake system for the following conditions: • Improper operation of caliper pistons • Kinked, pinched or damaged brake pipe or flexible brake hose • Brake fluid leak • Improperly functioning proportion valve, if equipped • Improper operation of dynamic rear proportion (DRP) system, if equipped 2. Adjust, repair or replace components as necessary. Refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*. Did you find and correct a condition?	Go to *Step 6*	Go to *Step 3*
3	1. Inspect the disc brake system for the following conditions: • Contaminated linings • Glazed linings • Distorted, cracked or damaged linings • Excessively worn linings • Aftermarket linings • Damaged or excessively worn caliper hardware and/or lining hardware • Hard spots, heat checks, blueing discoloration of rotor friction surfaces • Glazed rotor friction surfaces 2. Adjust, repair or replace components as necessary. Refer to *Disc Brake System Diagnosis on page 5-148*. Did you find and correct a condition?	Go to *Step 6*	Go to *Step 4*
4	1. Inspect the suspension system for the following conditions: • Loose suspension component connections • Excessively worn or damaged suspension components 2. Adjust, repair or replace components as necessary. Refer to *Diagnostic Starting Point - Vehicle on page 6-90*. Did you find and correct a condition?	Go to *Step 6*	Go to *Step 5*
5	1. Inspect the brake apply system for the following conditions: • Binding, bent or damaged pedal pushrod, pedal, or pedal bracket • Binding, bent or damaged brake pedal • Binding, bent or damaged brake pedal bracket 2. Adjust, repair or replace components as necessary. Refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*. Did you find and correct a condition?	Go to *Step 6*	Go to *Diagnostic Starting Point - Vehicle on page 6-90*

Braking Action Uneven - Front to Rear (cont'd)

Step	Action	Yes	No
6	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to *Brake System Vehicle Road Test on page 5-161*. Is the condition still present?	Go to *Step 2*	System OK

Brake Pedal Excessive Travel

Step	Action	Yes	No
DEFINITION: Brake pedal travels further than expected to obtain firm pedal and/or firm pedal cannot be obtained, pedal fades away, or pedal is spongy.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to *Step 2*	Go to *Symptoms - Hydraulic Brakes on page 5-136*
2	Inspect the travel and feel of brake pedal applies. Perform the following: 1. Ensure the ignition is OFF for at least 60 seconds to depressurize and deplete the power reserve. 2. With the ignition OFF, apply the brake pedal several times to verify the power reserve is fully depleted. 3. With power reserve depleted, apply the brake pedal with light, steady pressure and hold for 15 seconds. Observe pedal travel and feel. 4. Apply the brake pedal with light, steady pressure, then without pumping the pedal, reduce pressure and reapply pressure several times. Observe pedal travel and feel for each apply. 5. Apply the brake pedal slowly, then release and apply the pedal quickly. Observe pedal travel and feel for each apply. Did you complete the brake pedal travel and feel inspections?	Go to *Step 3*	—
3	1. Inspect the hydraulic brake system for the conditions listed, based on the following symptoms observed during the pedal travel and feel inspections: • Pedal feel was spongy – Air in hydraulic system – External brake fluid leaks – Soft, weak or damaged hydraulic hoses; expanding under pressure • Pedal fell away and/or traveled to or almost to floor – External brake fluid leaks – Poor brake fluid quality; low boiling point – Internal brake fluid leaks; improperly functioning master cylinder • Pedal was somewhat firm then dropped slightly, or pedal rose with successive applies, or pedal travel was different between slow and quick applies – Internal brake fluid leaks; improperly functioning master cylinder – Poor brake fluid quality; low boiling point • Pedal returned to rest slowly after any of the applies – Internally damaged flexible brake hoses; hindering fluid return – Binding caliper pistons – Internal brake fluid leaks; improperly functioning master cylinder 2. Repair or replace components as necessary. Refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*. 3. Re-inspect brake pedal apply travel and feel. Did you find and correct a condition?	Go to *Step 9*	Go to *Step 4*

Brake Pedal Excessive Travel (cont'd)

Step	Action	Yes	No
4	1. Inspect the disc brake system for the following conditions: • Cracked, excessively worn or damaged linings • Cracked, excessively worn or damaged rotors • Improperly operating, binding or damaged caliper hardware and/or lining hardware • Loose or missing caliper hardware and/or lining hardware • Excessive assembled lateral runout (LRO) of rotor friction surfaces • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to *Disc Brake System Diagnosis on page 5-148*. 3. Re-inspect brake pedal apply travel and feel. Did you find and correct a condition?	Go to *Step 9*	Go to *Step 5*
5	Inspect for proper brake pedal travel. Refer to *Brake Pedal Travel Measurement and Inspection on page 5-162*. Is the brake pedal travel distance within the acceptable limits?	Go to *Step 8*	Go to *Step 6*
6	1. Inspect for worn, missing, misaligned, bent or damaged brake pedal system components. • For the brake pedal pushrod component inspection, refer to *Brake Pedal Pushrod Inspection on page 5-165*. • Inspect the brake pedal bushings for binding, excessive wear and/or damage and inspect the brake pedal for a misaligned, bent, and/or damaged condition. 2. Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged. Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system components?	Go to *Step 9*	Go to *Step 7*
7	1. Replace the brake master cylinder assembly. 2. Inspect the brake pedal travel. Refer to *Brake Pedal Travel Measurement and Inspection on page 5-162*. Did you find and correct a condition?	Go to *Step 9*	Go to *Step 8*
8	1. Inspect the brake assist system for the following conditions: • Internal fluid leaks and/or restrictions within the brake modulator assembly • Damaged or improperly operating brake modulator assembly 2. Adjust, repair or replace components as necessary. Refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*. Did you find and correct a condition?	Go to *Step 9*	Go to *Symptoms - Hydraulic Brakes on page 5-136*
9	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to *Brake System Vehicle Road Test on page 5-161*. Is the condition still present?	Go to *Step 2*	System OK

Brake Pedal Excessive Effort

Step	Action	Yes	No
DEFINITION: Brake pedal requires an increased amount of input from the driver to obtain good braking action and/or stopping distance is increased.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to *Step 2*	Go to *Diagnostic Starting Point - Vehicle on page 6-90*

Brake Pedal Excessive Effort (cont'd)

Step	Action	Yes	No
2	1. Inspect the brake assist system for the following conditions: • Lack of lubrication, binding or excessively worn pushrod or pedal pivots or pivot bushings • Bent or damaged pedal pushrod, pedal, or pedal bracket 2. Adjust, repair or replace components as necessary. Refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*. Did you find and correct a condition?	Go to *Step 5*	Go to *Step 3*
3	1. Inspect the hydraulic brake system for the following conditions: • Binding caliper pistons • Internally damaged flexible brake hoses; hindering fluid flow • External brake fluid leaks • Kinked or damaged flexible brake hoses and/or pipes • Internal brake fluid leaks; improperly operating master cylinder • Poor brake fluid quality; low boiling point 2. Adjust, repair or replace components as necessary. Refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*. Did you find and correct a condition?	Go to *Step 5*	Go to *Step 4*
4	1. Inspect the disc brake system for the following conditions: • Excessively worn linings • Glazed linings • Cracked, distorted or damaged linings • Contaminated linings • Binding, damaged or excessively worn caliper hardware and/or lining hardware • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Excessively worn or corroded rotor friction surfaces • Glazed rotor friction surfaces • Hard spots, heat checks, blueing discoloration of rotor friction surfaces 2. Adjust, repair or replace components as necessary. Refer to *Disc Brake System Diagnosis on page 5-148*. Did you find and correct a condition?	Go to *Step 5*	Go to *Diagnostic Starting Point - Vehicle on page 6-90*
5	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to *Brake System Vehicle Road Test on page 5-161*. Is the condition still present?	Go to *Step 2*	System OK

Brakes Drag

Step	Action	Yes	No
DEFINITION: Brake system does not fully release or has delayed release; vehicle motion may be hindered by brake system without applying brakes.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to *Step 2*	Go to *Symptoms - Hydraulic Brakes on page 5-136*
2	Is the vehicle equipped with an adjustable stop lamp switch and/or an adjustable cruise control release switch?	Go to *Step 3*	Go to *Step 4*

Brakes Drag (cont'd)

Step	Action	Yes	No
3	1. Inspect the stop lamp switch for proper adjustment to ensure that the brake pedal is fully releasing. 2. Inspect the cruise control release switch, if equipped, for proper adjustment to ensure that the brake pedal is fully releasing. Did you find and correct a condition?	Go to *Step 14*	Go to *Step 4*
4	Is the vehicle equipped with a drum-in-rotor type of park brake system?	Go to *Step 5*	Go to *Step 7*
5	Ensure the park brake shoes are not adjusted too tightly, possibly causing drag under certain conditions. Are the park brake shoes adjusted too tightly?	Go to *Step 6*	Go to *Step 7*
6	1. Clean and inspect the park brake shoes for excessive wear and/or damage. 2. Inspect the drum portion of the rotors for excessive wear, blueing discoloration and heat spots. 3. If any of these conditions are present, replace the affected components. 4. Adjust the park brake system. Did you find and correct a condition?	Go to *Step 14*	Go to *Step 7*
7	Inspect the park brake system for proper operation. Refer to *Park Brake System Diagnosis on page 5-245*. Did you find and correct a condition?	Go to *Step 14*	Go to *Step 8*
8	1. Inspect the disc brake system for the following conditions: • Binding, incorrectly installed or missing caliper hardware and/or lining hardware—Ensure free movement of linings and of caliper, if equipped with sliding type caliper • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Distorted or damaged linings • Damaged or excessively worn caliper hardware and/or lining hardware • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to *Disc Brake System Diagnosis on page 5-148*. Did you find and correct a condition?	Go to *Step 14*	Go to *Step 9*
9	1. Separate the brake pushrod from the brake pedal. 2. Inspect the brake corners to determine if the brake drag condition is still present. Do the brake corners still exhibit the brake drag condition?	Go to *Step 11*	Go to *Step 10*
10	1. Inspect the pushrod for improper positioning and/or damage. Correctly position or replace the pushrod if necessary. 2. Inspect the brake pedal assembly for damage and replace if necessary. Did you complete the repair or replacement?	Go to *Step 14*	—
11	1. For vacuum boost systems, disconnect the vacuum check valve from the booster to relieve vacuum reserve. 2. Separate the master cylinder from the brake booster. Do not disconnect any brake pipes. 3. Inspect the brake corners to determine if the brake drag condition is still present. Do the brake corners still exhibit the brake drag condition?	Go to *Step 13*	Go to *Step 12*
12	Replace the master cylinder assembly. Did you complete the replacement?	Go to *Step 14*	—

Brakes Drag (cont'd)

Step	Action	Yes	No
13	1. Inspect the hydraulic brake system for the following conditions. • Improper operation of caliper pistons • Contaminated brake fluid • Internally damaged flexible brake hoses; hindering brake release • Damaged or improperly operating master cylinder 2. Adjust, repair or replace components as necessary. Refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*. Did you find and correct a condition?	Go to *Step 14*	Go to *Symptoms - Hydraulic Brakes on page 5-136*
14	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to *Brake System Vehicle Road Test on page 5-161*. Is the condition still present?	Go to *Step 2*	System OK

Brake System Slow Release

Step	Action	Yes	No
DEFINITION: Brake system releases and returns to rest slowly; vehicle motion is hindered by brake system briefly after release of brake pedal.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to *Step 2*	Go to *Symptoms - Hydraulic Brakes on page 5-136*
2	1. Inspect the hydraulic brake and assist system for the following conditions: • Improper operation of caliper pistons • Internally damaged flexible brake hoses; hindering brake release • Contaminated brake fluid • Damaged or improperly operating master cylinder • Damaged or improperly operating hydraulic booster, if equipped • Binding, bent or damaged pedal pushrod, pedal, or pedal bracket 2. Adjust, repair or replace components as necessary. Refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*. Did you find and correct a condition?	Go to *Step 4*	Go to *Step 3*
3	1. Inspect the disc brake system for the following conditions: • Damaged or excessively worn caliper hardware and/or lining hardware • Distorted or damaged linings • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to *Disc Brake System Diagnosis on page 5-148*. Did you find and correct a condition?	Go to *Step 4*	Go to *Symptoms - Hydraulic Brakes on page 5-136*
4	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to *Brake System Vehicle Road Test on page 5-161*. Is the condition still present?	Go to *Step 2*	System OK

Brake Fluid Loss

Step	Action	Yes	No
DEFINITION: Brake fluid level is low not related to lining wear.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to *Step 2*	Go to *Symptoms - Hydraulic Brakes on page 5-136*
2	1. Inspect the following hydraulic brake system components for brake fluid leaks: • Flexible brake hose connections; threaded and bolted • Flexible brake hose crimp joints • Brake pipe fittings • Caliper piston seals • Wheel cylinder piston seals, if equipped • Master cylinder reservoir • Master cylinder reservoir low pressure hose, if equipped • Brake pressure modulator valve (BPMV) assembly, if equipped 2. Repair or replace components as necessary. Refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153*. Did you find and correct a condition?	Go to *Step 8*	Go to *Step 3*
3	Is the vehicle equipped with a vacuum brake booster?	Go to *Step 4*	Go to *Step 6*
4	1. Disconnect the vacuum check valve from the booster to relieve vacuum reserve. 2. Separate the master cylinder from the vacuum brake booster. Do not disconnect any brake pipes. 3. Inspect the rear of the master cylinder for a brake fluid leak. 4. Inspect for brake fluid in the vacuum brake booster. Did you find a brake fluid leak?	Go to *Step 5*	Go to *Symptoms - Hydraulic Brakes on page 5-136*
5	Replace the brake master cylinder and the vacuum brake booster. Did you complete the replacement?	Go to *Step 8*	—
6	1. Wipe clean the external surface of the master cylinder to hydraulic brake booster area, if equipped. 2. Separate the master cylinder from the hydraulic brake booster, if equipped. Do not disconnect any brake pipes. 3. Inspect the rear of the master cylinder for a brake fluid leak. Did you find a brake fluid leak?	Go to *Step 7*	Go to *Symptoms - Hydraulic Brakes on page 5-136*
7	Replace the brake master cylinder. Did you complete the replacement?	Go to *Step 8*	—
8	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle to confirm proper operation. Refer to *Brake System Vehicle Road Test on page 5-161*. Is the condition still present?	Go to *Step 2*	System OK

Disc Brake System Diagnosis

Test Description

The numbers below refer to the step numbers on the diagnostic table:

9. Lubricant leaks from non-brake system components may come in contact with and contaminate brake system components.
10. Lubricant leaks from non-brake system components may come in contact with and contaminate brake system components.
12. Disc brake rotor shields/backing plates that come in contact with disc brake rotors may cause brake system noise.
15. Disc brake rotor thickness variation that exceeds the maximum acceptable level can cause brake pulsation.
19. Disc brake rotor thickness variation that exceeds the maximum acceptable level can cause brake pulsation.
22. Disc brake rotor assembled lateral runout (LRO) that exceeds the maximum acceptable level can lead to thickness variation.

Disc Brake System Diagnosis

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the DISC brake system in order to determine if the DISC brake system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Brake Symptom table?	Go to *Step 2*	Go to *Diagnostic Starting Point - Vehicle on page 6-90*
2	Visually inspect the disc brake pads for the following conditions: Refer to *Brake Pad Inspection on page 5-100*. • Lining thickness below specifications • Uneven and/or abnormal wear – edge-to-edge and/or side-to-side • Looseness or damage – including pad hardware • Evidence of contamination from an external substance Did you find any conditions to indicate a concern with any of the front and/or rear disc brake pads?	Go to *Step 3*	Go to *Step 12*
3	Are any of the front and/or rear disc brake pads contaminated?	Go to *Step 8*	Go to *Step 4*
4	Are any of the front and/or rear disc brake pads worn unevenly?	Go to *Step 7*	Go to *Step 5*
5	Are any of the front and/or rear disc brake pads and/or pad hardware loose or damaged?	Go to *Step 7*	Go to *Step 6*
6	1. Remove and inspect the worn disc brake pads for glazing, looseness, heat spots or damage. 2. Replace the worn disc brake pads as a complete axle set. Refer to *Front Disc Brake Pads Replacement on page 5-103* and/or *Rear Disc Brake Pads Replacement on page 5-105*. Did you complete the inspection and replacement?	Go to *Step 12*	—
7	**Caution:** Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak. **Note:** Do NOT disconnect the hydraulic brake flex hoses from the calipers. 1. Remove the front and/or rear disc brake calipers, as appropriate, from the mounting brackets or from the suspension knuckles and support the calipers. Refer to *Front Brake Caliper Replacement on page 5-108* and/or *Rear Brake Caliper Replacement on page 5-109*. 2. Inspect the disc brake caliper mounting bracket and the mounting/sliding hardware for the following conditions: Refer to *Front Disc Brake Mounting and Hardware Inspection on page 5-101* and/or *Rear Disc Brake Mounting and Hardware Inspection on page 5-102*. • Binding or seized hardware • Worn, damaged or missing hardware components • Loose, bent, cracked, or damaged caliper mounting bracket 3. Replace components as required. Refer to the following procedures, as required: • *Front Brake Caliper Bracket Replacement on page 5-116* • *Rear Brake Caliper Bracket Replacement on page 5-119* 4. Replace the unevenly-worn, loose or damaged disc brake pads as a complete axle set. Refer to *Front Disc Brake Pads Replacement on page 5-103* and/or *Rear Disc Brake Pads Replacement on page 5-105*. Did you complete the inspection and replacement?	Go to *Step 12*	—

Disc Brake System Diagnosis (cont'd)

Step	Action	Yes	No
8	1. Inspect the disc brake calipers, brake hoses and brake pipes for evidence of an external brake fluid leak. 2. Replace any components found to be leaking brake fluid. Refer to the following procedures as required: • *Front Brake Caliper Replacement on page 5-108* • *Rear Brake Caliper Replacement on page 5-109* • *Front Brake Hose Replacement on page 5-192* • *Rear Brake Hose Replacement on page 5-209* • *Brake Pressure Modulator Valve Pipe Replacement on page 5-179* • *Brake Pressure Modulator Valve Front Brake Pipe Replacement on page 5-181* • *Brake Pressure Modulator Valve Rear Brake Pipe Replacement on page 5-183* • *Front Brake Pipe Replacement - Right Side on page 5-186* • *Front Brake Pipe Replacement - Left Side on page 5-188* • *Rear Brake Intermediate Number 1 Pipe Replacement on page 5-194* • *Rear Brake Intermediate Number 2 Pipe Replacement on page 5-196* • *Rear Brake Pipe Replacement on page 5-199* • *Rear Brake Front Pipe Replacement (Left) on page 5-202* or *Rear Brake Front Pipe Replacement (Right) on page 5-205* • *Brake Pressure Modulator Valve Hose Replacement on page 5-176* Did you find and correct the source of the leak causing contamination of the pads?	Go to *Step 11*	Go to *Step 9*
9	1. Inspect the wheel drive shaft outer seals for damage and evidence of a grease leak. 2. Replace any wheel drive shaft seal that is found to be leaking grease which may be the source of the contamination to the pads. Did you find and correct the source of the leak causing contamination of the pads?	Go to *Step 11*	Go to *Step 10*
10	1. Inspect the automatic transmission cooling system lines, if equipped, for damage and evidence of an external fluid leak which may be the source of the contamination to the pads. 2. Inspect the power steering system hoses for damage and evidence of an external fluid leak which may be the source of the contamination to the pads. 3. Replace any components found to be leaking fluid which may be the source of the contamination to the pads. Did you find and correct the source of the leak causing contamination of the pads?	Go to *Step 11*	—

Disc Brake System Diagnosis (cont'd)

Step	Action	Yes	No
11	1. Clean the remaining disc brake system components to remove any traces of the contaminant. **Caution:** Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak. **Note:** Do NOT disconnect the hydraulic brake flex hoses from the calipers. 2. Remove the front and/or rear disc brake calipers, as appropriate, from the mounting brackets and support the calipers. Refer to *Front Brake Caliper Replacement on page 5-108* and/or *Rear Brake Caliper Replacement on page 5-109*. 3. Inspect the disc brake caliper mounting/sliding hardware for the following conditions: *Front Disc Brake Mounting and Hardware Inspection on page 5-101* and/or *Rear Disc Brake Mounting and Hardware Inspection on page 5-102*. • Binding or seized hardware • Distorted, worn, damaged or missing hardware components 4. Replace the caliper mounting/sliding hardware components as required. 5. Replace the contaminated disc brake pads as a complete axle set. Refer to *Front Disc Brake Pads Replacement on page 5-103* and/or *Rear Disc Brake Pads Replacement on page 5-105*. Did you complete the cleaning, inspection and replacement?	Go to *Step 12*	—
12	Visually inspect each of the rear disc brake rotor shields/backing plates, if equipped, for evidence of contact with the brake rotors. Are any of the brake rotor shields/backing plates contacting the brake rotors?	Go to *Step 13*	Go to *Step 14*
13	Repair or replace the disc brake rotor shields/backing plates as required. Refer to *Front Brake Shield Replacement on page 5-125* or *Rear Parking Brake Anchor Backing Plate Replacement on page 5-265*. Did you complete the repair or replacement?	Go to *Step 14*	—
14	1. Check the thickness of each of the disc brake rotors. **Note:** Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor. 2. Make a determination for each brake rotor if the rotor can be REFINISHED and REMAIN ABOVE the minimum requirements. Refer to *Brake Rotor Thickness Measurement on page 5-97*. Does the disc brake rotor meet the minimum requirements for REFINISHING?	Go to *Step 15*	Go to *Step 18*
15	**Note:** Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor. Inspect each of the disc brake rotors for thickness variation that exceeds the maximum acceptable level. Refer to *Brake Rotor Thickness Variation Measurement on page 5-97*. Does the brake rotor exhibit thickness variation that exceeds the maximum acceptable level?	Go to *Step 17*	Go to *Step 16*

Disc Brake System Diagnosis (cont'd)

Step	Action	Yes	No
16	1. Inspect each of the disc brake rotors for the following surface and wear conditions: Refer to *Brake Rotor Surface and Wear Inspection on page 5-98*. • Heavy rust and/or pitting • Cracks and/or heat spots • Excessive blueing discoloration • Deep or excessive scoring beyond maximum acceptable level **Note:** Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor. 2. Make a determination for each brake rotor if the rotor requires refinishing based upon the results of the inspection. If the brake rotor exhibits any of the conditions listed previously, it requires refinishing. Does the brake rotor require REFINISHING?	Go to *Step 17*	Go to *Step 22*
17	1. Refinish the brake rotor. Refer to *Brake Rotor Refinishing on page 5-130*. 2. Inspect the brake rotor thickness. Refer to *Brake Rotor Thickness Measurement on page 5-97*. Were you able to REFINISH the brake rotor within the minimum requirements?	Go to *Step 22*	Go to *Step 21*
18	Is the brake rotor at or below the DISCARD requirements?	Go to *Step 21*	Go to *Step 19*
19	**Note:** Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor. Inspect each of the disc brake rotors for thickness variation that exceeds the maximum acceptable level. Refer to *Brake Rotor Thickness Variation Measurement on page 5-97*. Does the brake rotor exhibit thickness variation that exceeds the maximum acceptable level?	Go to *Step 21*	Go to *Step 20*
20	1. Inspect each of the disc brake rotors for the following surface and wear conditions: Refer to *Brake Rotor Surface and Wear Inspection on page 5-98*. • Heavy rust and/or pitting • Cracks and/or heat spots • Excessive blueing discoloration • Deep or excessive scoring beyond maximum acceptable level **Note:** Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor. 2. Make a determination for each brake rotor if the rotor requires replacement based upon the results of the inspection. If the brake rotor exhibits any of the conditions listed previously, it requires replacement. Does the brake rotor require REPLACEMENT?	Go to *Step 21*	Go to *Step 22*
21	**Note:** Whenever a brake rotor is replaced, the assembled lateral runout (LRO) of the rotor must be measured to ensure optimum performance of the disc brakes. Replace the brake rotor. Refer to *Front Brake Rotor Replacement on page 5-122* or *Rear Brake Rotor Replacement on page 5-124*. Did you complete the replacement?	Go to *Step 24*	—

Disc Brake System Diagnosis (cont'd)

Step	Action	Yes	No
22	**Note:** Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor. Inspect each of the disc brake rotors for assembled LRO that exceeds the maximum acceptable level. Refer to *Brake Rotor Assembled Lateral Runout Measurement on page 5-98.* Does the brake rotor exhibit assembled LRO that exceeds the maximum acceptable level?	Go to *Step 23*	Go to *Step 24*
23	Correct the LRO for each brake rotor that was determined to have LRO exceeding the maximum acceptable level. Refer to *Brake Rotor Assembled Lateral Runout Measurement on page 5-98.* Did you complete the operation?	Go to *Step 24*	—
24	Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?	Disc Brake System OK Return to Symptom Table	—

Brake Hydraulic and Assist System Diagnosis

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the brake HYDRAULIC and ASSIST systems in order to determine if the HYDRAULIC and ASSIST systems are operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Brake Symptom table or from an electrical diagnostic procedure?	Go to *Step 2*	Go to *Symptoms - Hydraulic Brakes on page 5-136*
2	1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination: • Fluid separation, indicating two types of fluid are present – Swirled appearance – oil-based substance – Layered appearance – silicone-based substance • Fluid discoloration – Cloudy appearance – moisture – Dark appearance/suspended particles in fluid – dirt, rust, corrosion, brake dust 2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating fluid contamination. Do any of the above fluid contamination conditions exist?	Go to *Step 3*	Go to *Step 4*
3	1. Flush the hydraulic brake system and repair or replace components as directed based upon the type of fluid contamination present. Refer to *Hydraulic Brake System Flushing on page 5-213.* 2. Pressure bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212.* 3. Perform the *Antilock Brake System Automated Bleed on page 5-72.* Did you complete the operation and any required repairs and/or replacements?	Go to *Step 4*	—

Brake Hydraulic and Assist System Diagnosis (cont'd)

Step	Action	Yes	No
4	1. Inspect the following hydraulic brake system components for external fluid leaks: • Hydraulic brake hoses • Hydraulic brake pipes • Brake master cylinder reservoir to brake pressure modulator valve (BPMV) feed and return hoses • Brake calipers • Brake master cylinder • BPMV 2. Inspect the hydraulic brake pipes, master cylinder reservoir hoses, and flexible brake hoses for signs of a fluid restriction, such as being bent, kinked, pinched, or damaged. Refer to *Brake Pipe and Hose Inspection on page 5-164*. 3. Repair or replace any of the hydraulic components found to be leaking brake fluid. 4. Replace any of the hydraulic brake pipes, master cylinder reservoir hoses, and/or flexible brake hoses found to be bent, kinked, pinched, or damaged. Refer to the appropriate procedures: • *Master Cylinder Replacement on page 5-168* Brake master cylinder reservoir cap diaphragm • *Front Brake Hose Replacement on page 5-192* • *Rear Brake Hose Replacement on page 5-209* • *Brake Pressure Modulator Valve Pipe Replacement on page 5-179* • *Brake Pressure Modulator Valve Front Brake Pipe Replacement on page 5-181* • *Brake Pressure Modulator Valve Rear Brake Pipe Replacement on page 5-183* • *Front Brake Pipe Replacement - Right Side on page 5-186* • *Front Brake Pipe Replacement - Left Side on page 5-188* • *Rear Brake Intermediate Number 1 Pipe Replacement on page 5-194* • *Rear Brake Intermediate Number 2 Pipe Replacement on page 5-196* • *Rear Brake Pipe Replacement on page 5-199* • *Rear Brake Front Pipe Replacement (Left) on page 5-202* or *Rear Brake Front Pipe Replacement (Right) on page 5-205* • *Brake Pressure Modulator Valve Hose Replacement on page 5-176* • *Front Brake Caliper Overhaul on page 5-110* or *Front Brake Caliper Replacement on page 5-108* • *Rear Brake Caliper Overhaul on page 5-113* or *Rear Brake Caliper Replacement on page 5-109* • *Brake Pressure Modulator Valve Replacement on page 5-76* Did you complete the inspections and any necessary repairs or replacements?	Go to *Step 5*	—

Brake Hydraulic and Assist System Diagnosis (cont'd)

Step	Action	Yes	No
5	Perform the system deactivation and vehicle preparation steps: **Note:** To ensure the complete brake modulator and high pressure accumulator (HPA) pressure relief procedure is allowed to occur; the brake controller must see 1 pedal apply with the propulsion system enabled, followed by a proper shutdown without applying the brake pedal. 1. Enable the propulsion system. 2. Apply and release the brake pedal. 3. Place the transmission in PARK. **Note:** The power button must be in the OFF position, and without applying the brake pedal to ensure the brake modulator and high pressure accumulator (HPA) pressure relief occurs. This process will take approximately 1–3 minutes. 4. Place the power button in the OFF position, without applying the brake pedal. 5. Remove the remote keyless entry (RKE) transmitter and close all of the vehicle doors. 6. Wait approximately 1–3 minutes until the brake modulator and HPA pressure relief is complete. 7. Inspect and adjust the brake fluid level in the brake master cylinder reservoir. Refer to *Master Cylinder Reservoir Filling on page 5-165*. 8. Ensure stable 12V battery voltage is maintained and install a scan tool. Refer to *Electronic Brake Control Module Programming and Setup on page 6-9*. **Note:** The power button must remain in the ON/RUN position, with the engine OFF during the remainder of this diagnostic procedure, unless otherwise instructed. 9. Place the power button in the ON/RUN position. 10. Ensure the scan tool is communicating with the vehicle. Did you complete the system deactivation and vehicle preparation steps?	Go to *Step 6*	—
6	Have you already performed the brake sensor performance data checks as part of an electrical DTC diagnostic procedure?	Go to *Step 8*	Go to *Step 7*

Brake Hydraulic and Assist System Diagnosis (cont'd)

Step	Action	Yes	No
7	Perform the brake sensor performance data check procedure. 1. Place the power button in the ON/RUN position. 2. Place the transmission in PARK. **Note:** Do not depress the brake pedal during the electronic brake control module learn. 3. Using the scan tool, perform the electronic brake control module learn. Do not depress the brake pedal. 3.1. Select Diagnostics. 3.2. Enter the VIN. 3.3. Select Module Diagnostics. 3.4. Select Configuration/Reset Functions. 3.5. Select Electronic Brake Control Module Learn and follow the scan tool instructions. **Note:** To ensure the complete brake modulator and high pressure accumulator (HPA) pressure relief procedure is allowed to occur; the brake controller must see 1 pedal apply with the propulsion system enabled, followed by a proper shutdown without applying the brake pedal. 4. Enable the propulsion system. 5. Apply and release the brake pedal. **Note:** The power button must be in the OFF position, and without applying the brake pedal to ensure the brake modulator and high pressure accumulator (HPA) pressure relief occurs. This process will take approximately 1–3 minutes. 6. Place the power button in the OFF position, without applying the brake pedal. 7. Remove the remote keyless entry (RKE) transmitter and close all of the vehicle doors. 8. Wait approximately 1–3 minutes until the brake modulator and HPA pressure relief is complete. **Note:** The power button must remain in the ON/RUN position, with the engine OFF during the remainder of this diagnostic procedure, unless otherwise instructed. 9. Place the power button in the ON position, engine OFF, and do not apply the brake pedal. 10. Using the scan tool, select Data Display for the electronic brake control module, scroll through the data list, select and accept the following: • Brake Pressure Sensor • High Pressure Accumulator Sensor • Brake Master Cylinder Pressure Sensor • Brake Controls Brake Pedal Position Sensor Circuit 1 • Brake Controls Brake Pedal Position Sensor Circuit 2 • Brake Controls Brake Pedal Position Sensor 5V Supply Voltage 11. Power button ON, engine OFF, brakes not applied, verify the scan tool parameters listed are within the specified range: • Brake Pressure Sensor - Less than 100 kPa (15 psi) • High Pressure Accumulator Sensor - Less than 800 kPa (116 psi) • Brake Master Cylinder Pressure Sensor - Less than 100 kPa (15 psi) 12. If any of the sensor parameters on the scan tool are not within the specified ranges, replace the BPMV. Refer to *Brake Pressure Modulator Valve Replacement on page 5-76*.	Go to *Step 8*	—

Brake Hydraulic and Assist System Diagnosis (cont'd)

Step	Action	Yes	No
	13. With the power button ON, engine OFF, brakes not applied, verify the scan tool parameters listed are within the specified range: • Brake Controls Brake Pedal Position Sensor Circuit 1 - Between 1.4V and 1.7V • Brake Controls Brake Pedal Position Sensor Circuit 2 - Between 58% and 78% • Brake Controls Brake Pedal Position Sensor 5V Supply Voltage - Between 4.75V and 5.25V 14. If any of the sensor parameters are not within the specified ranges, see DTC C029C for further diagnostic information. Did you complete the operation and any required repairs and/or replacements?		
8	Inspect for proper brake pedal travel. Refer to *Brake Pedal Travel Measurement and Inspection on page 5-162*. Was the brake pedal travel within specification?	Go to *Step 10*	Go to *Step 9*
9	1. Inspect for worn, missing, misaligned, bent or damaged brake pedal system components. • For the brake pedal pushrod component inspection, refer to *Brake Pedal Pushrod Inspection on page 5-165*. • Inspect the brake pedal bushings for excessive wear and/or damage and inspect the brake pedal for a misaligned, bent and/or damaged condition. 2. Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged. 3. Perform the entire *Antilock Brake System Automated Bleed on page 5-72*. 4. Re-inspect for proper brake pedal travel. Refer to *Brake Pedal Travel Measurement and Inspection on page 5-162*. Is the brake pedal now within specification?	Go to *Step 10*	Go to *Step 20*
10	Perform the brake master cylinder primary circuit test: **Note:** The power button must remain in the ON position, engine OFF during this entire procedure. 1. Ensure the power button is ON, engine OFF. 2. Using the scan tool, select Data Display for the electronic brake control module, scroll through the Data list, select and accept the following: • Brake Master Cylinder Pressure Sensor • Brake Pressure Sensor 3. While observing the brake master cylinder pressure and the brake pressure sensor on the scan tool data display, using moderate speed and moderate effort, apply and maintain the brake pedal to a force of 2500 kPa (363 psi). 4. Wait for 10 seconds for the system to settle. 5. While ensuring 2500 kPa (363 psi) of force is maintained, observe pedal operation for an additional 30 seconds. **Note:** The brake pedal should remain firm and steady while maintaining the apply force during the observation period. Did the brake pedal remain firm and steady during the observation period?	Go to *Step 11*	Go to *Step 20*

Brake Hydraulic and Assist System Diagnosis (cont'd)

Step	Action	Yes	No
11	Ensure the brake corners are functioning properly: ***Danger: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.*** **Note:** The aid of an assistant will be necessary. 1. Raise and support the vehicle. Allow the tire and wheel assemblies to rotate freely. Refer to *Lifting and Jacking the Vehicle on page 1-27*. **Note:** The power button must remain in the ON position, engine OFF during this entire procedure. 2. Ensure the power button is in the ON position, engine OFF. 3. Verify the park brake is released. 4. Place the transmission in NEUTRAL. 5. Continue observing the brake master cylinder pressure sensor on the scan tool data display. 6. Using moderate speed and moderate effort, apply and maintain the brake pedal to a force of 2500–3000 kPa (363–435 psi). 7. While maintaining the brake apply force, wait 10 seconds, then have an assistant attempt to rotate the rear wheels. 8. If the rear wheels are locked, maintain that amount of apply force. 9. If the rear wheels are not locked, increase the apply force just enough to lock the rear wheels. Maintain that amount of apply force. 10. Have an assistant attempt to rotate the front wheels. 11. Inspect any suspect brake corners for possible component hydraulic restriction and/or mechanical binding. 12. Release the brake pedal and have an assistant rotate each of the wheels again to check for possible brake drag. **Note:** None of the wheels should be able to be rotated during the brake apply. None of the wheels should exhibit drag after brake release. Did the brake corners apply and release properly?	Go to *Step 14*	Go to *Step 12*
12	Determine if the brake caliper is restricting the flow of brake fluid and/or not operating properly. 1. Remove the appropriate tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*. 2. Inspect the hydraulic function of the brake caliper for proper operation. Refer to *Hydraulic Brake Component Operation Visual Inspection on page 5-163*. 3. Open the suspected caliper bleeder valve. 4. Using a large C-clamp or clamps, evenly compress the caliper piston or pistons. Observe for an unrestricted flow of brake fluid and for free movement of the caliper piston or pistons. 5. Close the caliper bleeder valve. Was the flow of brake fluid unrestricted and did the caliper piston or pistons move freely?	Go to *Step 13*	Go to *Step 19*
13	Determine if the brake hose is restricting the flow of brake fluid. 1. Carefully inspect the flexible brake hose at the restricted location for signs of a fluid restriction, such as being bent, kinked, pinched, or damaged. Refer to *Brake Pipe and Hose Inspection on page 5-164*. 2. Replace the brake hose if it is found to be damaged. Refer to the appropriate procedure: • *Front Brake Hose Replacement on page 5-192* • *Rear Brake Hose Replacement on page 5-209* Did you complete the inspection and any necessary replacement?	Go to *Step 14*	—

Brake Hydraulic and Assist System Diagnosis (cont'd)

Step	Action	Yes	No
14	Perform the BMC secondary circuit test. **Note:** The aid of an assistant will be necessary. 1. Reinstall the tire and wheel assembly, if removed previously to verify brake corner function. 2. With the vehicle still supported at a working height, allow the tire and wheel assemblies to rotate freely. **Note:** The power button must remain in the ON position, engine OFF during this entire procedure. 3. Ensure the power button is ON, engine OFF and the transmission is in NEUTRAL. 4. Continue observing the brake master cylinder pressure sensor on the scan tool data display. 5. Using moderate speed and moderate effort, apply and maintain the brake pedal to a force of 2500–3000 kPa (363–435 psi). 6. While maintaining the brake pedal apply force, wait 10 seconds, then have an assistant attempt to rotate the rear wheels. 7. If the rear wheels are locked, maintain that amount of apply force. 8. If the rear wheels are not locked, increase the apply force just enough to lock the rear wheels. Maintain that amount of apply force. 9. Wait 20 seconds, then attempt to rotate the front wheels. 10. Attempt to rotate the rear wheels again. **Note:** None of the wheels should be able to be rotated during the brake apply. Could any of the wheels be rotated during the brake apply?	Go to *Step 15*	Go to *Step 18*
15	Were either of the front wheels able to be rotated during the brake apply?	Go to *Step 20*	Go to *Step 16*
16	Perform the High Pressure Accumulator Sensor test: 1. Using the scan tool data display, scroll through the Data List, select and accept High Pressure Accumulator Sensor. 2. While observing the high pressure accumulator sensor data, start the engine and allow it to idle to activate and pressurize the brake system. 3. Observe the high pressure accumulator sensor data for 40 seconds. **Note:** The high pressure accumulator sensor data should rise from 0 kPa (0 psi) to 17,000 kPa (2466 psi) within 40 seconds. Did the brake modulator provide the specified amount of pressure within the allotted time period?	Go to *Step 18*	Go to *Step 17*

Brake Hydraulic and Assist System Diagnosis (cont'd)

Step	Action	Yes	No
17	1. Perform the entire brake system automated bleed procedure. Refer to *Antilock Brake System Automated Bleed on page 5-72*. 2. Place the transmission in PARK. **Note:** The ignition must be OFF, without pausing at ACCESSORY, and without applying the brake pedal to ensure the high pressure accumulator (HPA) pressure relief occurs. This process will take approximately 1–3 minutes. 3. Place the power button in the OFF position, without applying the brake pedal. 4. Wait approximately 1–3 minutes until the high pressure accumulator pressure relief is complete. 5. Again perform the high pressure accumulator pressure test: 5.1. Using the scan tool data display, scroll through the Data List, select and accept High Pressure Accumulator Sensor. 5.2. While observing the high pressure accumulator sensor data, activate the propulsion system to activate and pressurize the brake system. 5.3. Observe the high pressure accumulator sensor data for 40 seconds. **Note:** The high pressure accumulator sensor should rise from 0 kPa (0 psi) to 17,000 kPa (2466 psi) within 40 seconds. Did the high pressure accumulator provide the specified amount of pressure within the allotted time period?	Go to *Step 18*	Go to *Step 21*
18	Perform the brake pedal simulator test: 1. Activate the propulsion system to activate and pressurize the brake system. 2. Continue observing the brake master cylinder pressure sensor and the brake controls brake pedal position sensors on the scan tool data display. 3. Using moderate speed and moderate effort, apply and maintain the brake pedal to a force of 2500 kPa (363 psi). 4. Observe both pedal operation and brake master cylinder pressure for a period of 20 seconds. **Note:** The brake pedal should remain firm and steady and master cylinder pressure should remain constant. Did the brake pedal remain firm and steady, and did the master cylinder pressure remain constant?	Go to *Step 22*	Go to *Step 21*
19	Repair or replace any brake caliper that was not operating properly. Refer to the appropriate procedure: • *Front Brake Caliper Replacement on page 5-108* or *Front Brake Caliper Overhaul on page 5-110* • *Rear Brake Caliper Replacement on page 5-109* or *Rear Brake Caliper Overhaul on page 5-113* Did the brake pedal remain firm and steady, and did the master cylinder pressure remain constant?	Go to *Step 22*	—
20	1. Replace the brake master cylinder. Refer to *Master Cylinder Replacement on page 5-168*. 2. Pressure bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*. 3. Perform the entire brake system automated bleed procedure. Refer to *Antilock Brake System Automated Bleed on page 5-72*. Did you complete the replacement and repair procedures?	Go to *Step 22*	—

Brake Hydraulic and Assist System Diagnosis (cont'd)

Step	Action	Yes	No
21	1. Replace the BPMV. Refer to *Brake Pressure Modulator Valve Replacement on page 5-76*. 2. Pressure bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*. 3. Perform the entire brake system automated bleed procedure. Refer to *Antilock Brake System Automated Bleed on page 5-72*. Did you complete the replacement and repair procedures?	Go to *Step 22*	—
22	Install or connect any components that were removed or disconnected during diagnosis. Did you complete the operation?	Brake Hydraulic and Assist System OK Return to Symptom Table	—

Brake System Vehicle Road Test

Preliminary Inspections

1. Visually inspect easily accessible brake system components for obvious damage and/or leaks which may indicate that the vehicle should not be driven until further inspections have been completed.
2. Inspect the brake master cylinder reservoir fluid level and adjust only if necessary for brake system road testing. Refer to *Master Cylinder Reservoir Filling on page 5-165*.
3. Inspect the tire inflation pressures and adjust as necessary.
4. Inspect the tire tread patterns to ensure that they are the same or very similar, especially per axle.
5. Ensure that the vehicle is not loaded unevenly prior to brake system road testing.

Road Testing Procedure

Warning: Road test a vehicle under safe conditions and while obeying all traffic laws. Do not attempt any maneuvers that could jeopardize vehicle control. Failure to adhere to these precautions could lead to serious personal injury and vehicle damage.

1. Start the engine and allow it to idle.
2. Check to see if the brake system warning lamp remains illuminated.
3. If the brake system warning lamp remains illuminated, DO NOT proceed to test drive the vehicle until it is diagnosed and repaired. Refer to *Symptoms - Hydraulic Brakes on page 5-136*.
4. Select a smooth, dry, clean and level road or large lot that is as free of traffic and obstacles as possible for brake system low speed road testing.
5. With the transmission in PARK, lightly apply the brake pedal. Observe both the pedal feel and the pedal travel.
6. If the brake pedal apply felt spongy, or the pedal travel was excessive, DO NOT drive the vehicle until it is repaired.
7. If the brake pedal apply did not feel spongy and the pedal travel was not excessive, proceed to step 8.
8. Release and apply the brakes.
9. While continuing to apply the brakes, shift the transmission into DRIVE, release the brakes and allow the engine to idle the vehicle away from the stopped position. Observe for a slow release of the brake system.
10. With the aid of an assistant to observe the vehicle's performance from outside of the vehicle, drive the vehicle at a low speed and lightly apply the brakes while driving past the assistant. Have the assistant observe for brake system noise from the side of the vehicle closest to them, while you observe both the pedal effort and the pedal travel.
11. If the brake pedal apply effort was excessive, or the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.
12. If the brake pedal apply effort was not excessive and the pedal travel was not excessive, proceed to step 13.
13. Drive the vehicle in the opposite direction, at the same low speed and lightly apply the brakes while driving past the assistant. Have the assistant observe for brake system noise from the side of the vehicle closest to him.
14. Drive the vehicle at a low speed and shift the transmission into NEUTRAL without applying the brakes. Observe for a rapid deceleration in vehicle speed, indicating possible brake drag.
15. Select a smooth, dry, clean and level road that is as free of heavy traffic as possible for brake system moderate speed road testing.
16. Drive the vehicle at a moderate speed. Observe for a pull and/or incorrect tracking of the vehicle without the brakes applied.
17. While continuing to drive the vehicle at a moderate speed, perform several light applies of the brakes. Observe the pedal effort and the pedal travel, observe for brake system noise, pulsation and/or brake drag.
18. If the brake pedal apply effort was excessive, or the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.
19. If the brake pedal apply effort was not excessive and the pedal travel was not excessive, proceed to step 20.

20. While continuing to drive the vehicle at a moderate speed, perform several moderate applies of the brakes. Observe the pedal effort and the pedal travel, observe for brake system pulsation and/or uneven braking action – either side to side, or front to rear.

    A small amount of vehicle front end dip is expected during a moderate apply of the brakes.

21. If the brake pedal apply effort was excessive, or the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.

Brake Pedal Travel Measurement and Inspection

Note: The brake corners must be cool to obtain the most accurate measurement.

Note: To ensure the complete brake modulator and high pressure accumulator (HPA) pressure relief procedure is allowed to occur, the brake controller must see one pedal apply with the propulsion system enabled, followed by a proper shutdown without applying the brake pedal.

1. Enable the propulsion system.
2. Apply and release the brake pedal.
3. Place the transmission in PARK.

   Note: The power button must be in the OFF position and without applying the brake pedal to ensure the brake modulator and HPA pressure relief occurs. This process will take approximately 1-3 minutes.

4. Place the power button in the OFF position, without applying the brake pedal.
5. Remove the remote keyless entry (RKE) transmitter and close all the vehicle doors.
6. Wait approximately 1-3 minutes until the brake modulator and HPA pressure relief is complete.
7. Inspect the battery state of charge. Refer to *Battery Inspection/Test on page 9-15*.
8. If necessary, connect a battery charger to the 12V battery. Refer to *Battery Charging on page 9-16*.
9. Install a scan tool to the vehicle.
10. Place the power button in the ON position without applying the brake pedal.
11. Using the scan tool, perform the following steps:
    11.1. Select Diagnostics
    11.2. Enter the VIN
    11.3. Select Electronic Brake Control Module (EBCM)
    11.4. Select Data Display
    11.5. Scroll through the Data List, select and accept Brake Controls Brake Pedal Position Sensor without Offset and Brake Master Cylinder Pressure Sensor
12. While observing the master cylinder pressure on the scan tool data display, using moderate speed and moderate effort, apply the brake pedal to a force of 5000 kPa (725 psi).
13. Record the distance displayed on the scan tool that the brake pedal has travelled at a pedal apply force of 5000 kPa (725 psi).
14. Release the brake pedal.

Specification

Maximum brake pedal travel, (measured with the power button ON, engine OFF and the brakes cool), at a brake pedal apply force of 5000 kPa (725 psi): 18 mm (0.71 in)

Brake System External Leak Inspection

Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

1. In order to inspect for external brake fluid leaks, first check the fluid level in the master cylinder.

   While a slight brake fluid level drop can be considered a normal condition due to brake lining wear, a very low level may indicate a brake fluid leak in the hydraulic system.

   If the fluid level is abnormally low, adjust the brake fluid level. Refer to *Master Cylinder Reservoir Filling on page 5-165*.

2. Start the engine and allow it to idle.
3. Apply constant, moderate foot pressure to the brake pedal.

   If the brake pedal gradually falls away while under foot pressure, there may be a brake fluid leak.

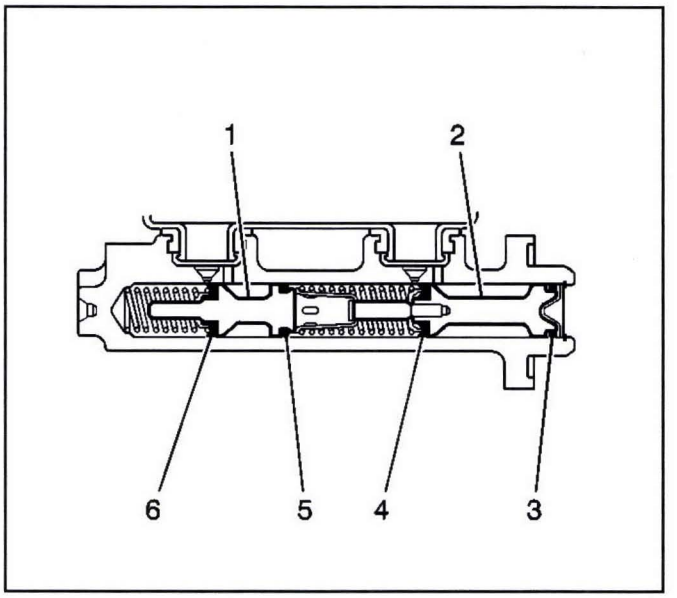
4. Turn OFF the ignition.
5. Visually inspect the following brake system components for brake fluid leaks, excessive corrosion, and damage. Give particular attention to all brake pipe and flexible hose connections to ensure that there are not any slight brake fluid leaks – even though the brake pedal may feel firm and hold steady:
   - Master cylinder brake pipe fittings
   - All brake pipe connections
   - Brake pipes
   - Brake hoses and connections
   - Brake calipers and/or wheel cylinders, if equipped
6. While slight dampness around the master cylinder reservoir can be considered acceptable, brake fluid leaking from any of the brake system components requires immediate attention. If any of these components exhibit signs of brake fluid leakage, repair or replace those components. After the repair or replacement, reinspect the hydraulic brake system to assure proper function.

Brake System Internal Leak Test

Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

1. Ensure is ignition is OFF for at least 60 seconds to allow the system to depressurize and deplete the power reserve.
2. Apply the brake pedal several times to verify the power reserve is fully depleted.
3. Apply light, steady pressure to the brake pedal. Observe both the brake pedal feel and travel.
4. Release the brake pedal.
5. If the brake pedal apply felt spongy, but the brake pedal travel was not excessive, perform the following steps:
   5.1. Inspect the brake system for external leaks. Refer to *Brake System External Leak Inspection on page 5-162*.
   5.2. Pressure bleed the brake system in order to purge any air that may be trapped in the system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*.



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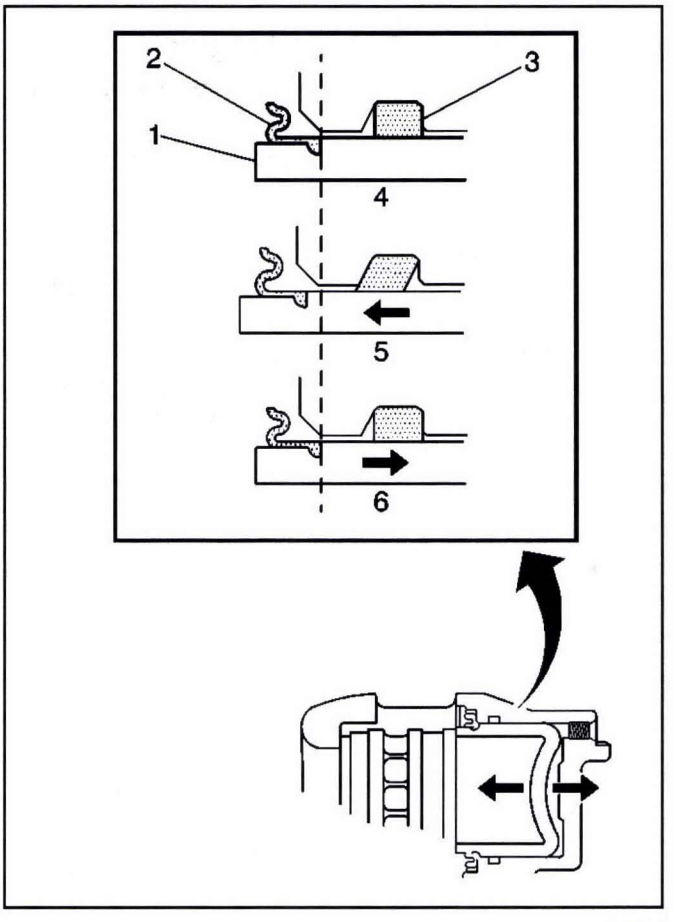
6. If the brake pedal apply did not feel spongy, but the brake pedal travel was excessive, perform the following steps:
   6.1. Loosen the master cylinder-to-adapter mounting nuts.
   6.2. Carefully pull the master cylinder away from the adapter just enough to inspect the mounting surface of the master cylinder.
   6.3. Inspect the master cylinder mounting surface at the primary piston (2) for brake fluid leaks.
7. If the master cylinder exhibits any leakage around the primary piston (2), then the primary piston primary seal (4) and/or secondary seal (3) is leaking and the master cylinder requires replacement.
8. If the master cylinder primary piston (2) does not exhibit any leakage, install the master cylinder to the adapter and pressure bleed the brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*.
9. If the brake pedal apply did not feel spongy, and the brake pedal travel was initially steady and not excessive, but then gradually fell, then the master cylinder requires replacement due to an internal leak past a piston seal.
10. If the brake pedal apply did not feel spongy, and the brake pedal travel was initially steady and not excessive, then fell slightly, then became steady again, then the brake pressure modulator valve (BPMV) may be leaking internally, and may require replacement.

Hydraulic Brake Component Operation Visual Inspection



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Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

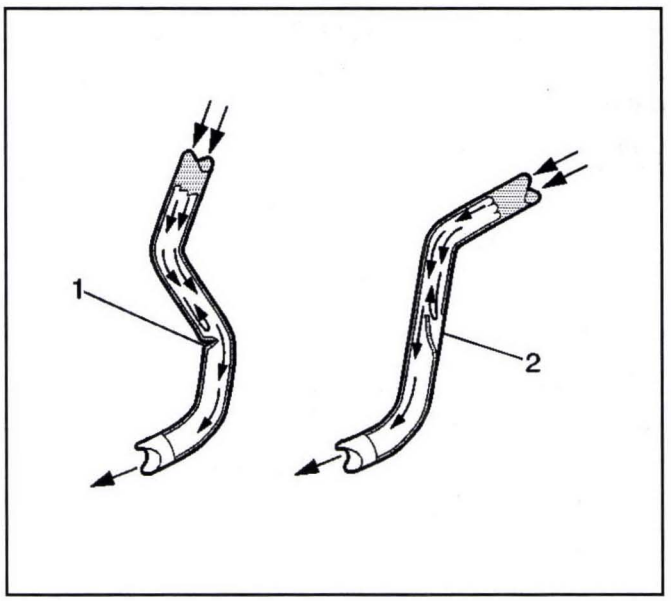
1. With the tire and wheel assemblies removed and the brake rotors retained by wheel lug nuts, visually inspect the caliper piston dust boot (2) sealing area to ensure that there are no brake fluid leaks.
2. If any evidence of a brake fluid leak is present, the brake caliper requires overhaul or replacement.
3. While the brake system is at rest (4), observe the position of the caliper piston (1) in relation to the caliper housing.
4. Have an assistant apply and release the brake pedal several times while you observe the operation of the hydraulic brake caliper.
   4.1. Observe the caliper piston (1) for unrestricted and even movement during each apply of the brake system (5).
   4.2. Observe the caliper piston (1) for an unrestricted and even return motion during each release of the brake system (6).
5. If the caliper piston (1) did not exhibit unrestricted and even movement during brake system apply and/or release, the piston square seal (3) may be worn or damaged and the caliper may require overhaul or replacement.

Brake Pipe and Hose Inspection

Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

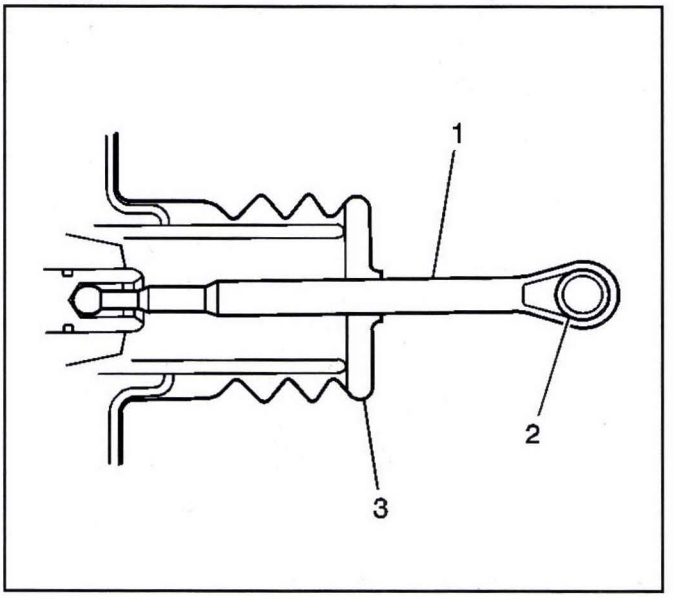
1. Visually inspect all of the brake pipes for the following conditions:
   - Kinks, improper routing, missing or damaged retainers
   - Leaking fittings, excessive corrosion
2. If any of the brake pipes exhibited any of the conditions listed, then the identified pipe, or pipes, require replacement.
3. Ensure that the vehicle axles are properly supported at ride height in order to maintain the proper relationship of the flexible brake hoses to the chassis.



681071

4. Visually inspect all of the flexible brake hoses for the following conditions:
   - Kinks (1), improper routing, twists, chafing, missing or damaged retainers
   - Leaking connections, cracking, dry-rot, blisters, bulges
5. If any of the flexible brake hoses exhibited any of the conditions listed, then the identified flexible brake hose, or hoses require replacement.
6. Squeeze the flexible brake hoses with firm finger pressure to check for soft spots (2), indicating an internal restriction. Check the entire length of each flexible brake hose.
7. If any of the flexible brake hoses were found to have soft spots (2), then the identified flexible brake hose, or hoses require replacement.

Brake Pedal Pushrod Inspection



681075

1. Disconnect the brake pedal pushrod (1) from the brake pedal.
2. Inspect the brake pedal pushrod eyelet bushing (2), if equipped, for cracks and/or excessive wear.
3. Reposition the pedal pushrod boot (3) toward the front of the vehicle to expose as much of the pedal pushrod (1) as possible.
4. Inspect the brake pedal pushrod (1) for straightness.
5. If the brake pedal pushrod eyelet bushing (2) exhibited cracks and/or excessive wear, then the bushing requires replacement.
6. If the brake pedal pushrod (1) is not straight, then the pushrod requires replacement.
7. Return the pedal pushrod boot (3) to its original position on the pedal pushrod (1).
8. Connect the brake pedal pushrod (1) to the brake pedal.

Repair Instructions

Master Cylinder Reservoir Filling

Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Caution: Only use products that comply with GM specifications and check manufacturer information respectively. We recommend the use of GM genuine products. Instructions must be followed at all times. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

1. Visually inspect the brake fluid level through the brake master cylinder reservoir.
2. If the brake fluid level is at or below the half-full point during routine fluid checks, the brake system should be inspected for wear and possible brake fluid leaks.
3. If the brake fluid level is at or below the half-full point during routine fluid checks, and an inspection of the brake system did not reveal wear or brake fluid leaks, the brake fluid may be topped-off up to the maximum-fill level.
4. If brake system service was just completed, the brake fluid may be topped-off up to the maximum-fill level.
5. If the brake fluid level is above the half-full point, adding brake fluid is not recommended under normal conditions.
6. If brake fluid is to be added to the master cylinder reservoir, clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.
7. Use only GM approved brake fluid from a clean, sealed brake fluid container. Refer to *Adhesives, Fluids, Lubricants, and Sealers on page 5-133*.

Master Cylinder Reservoir Replacement

Removal Procedure

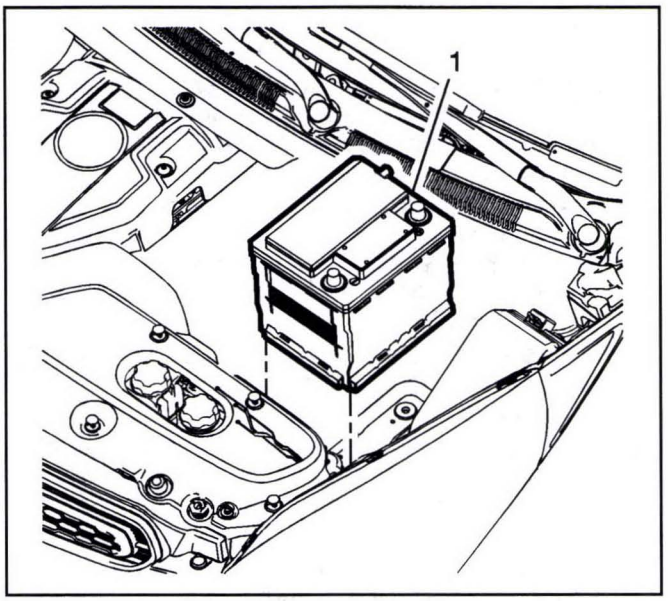
Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

Note: The transmission must be in the PARK position, the power button in the OFF position, and the brakes not applied to ensure the brake modulator and high pressure accumulator (HPA) pressure relief occurs. This process will take approximately 1 to 3 minutes.

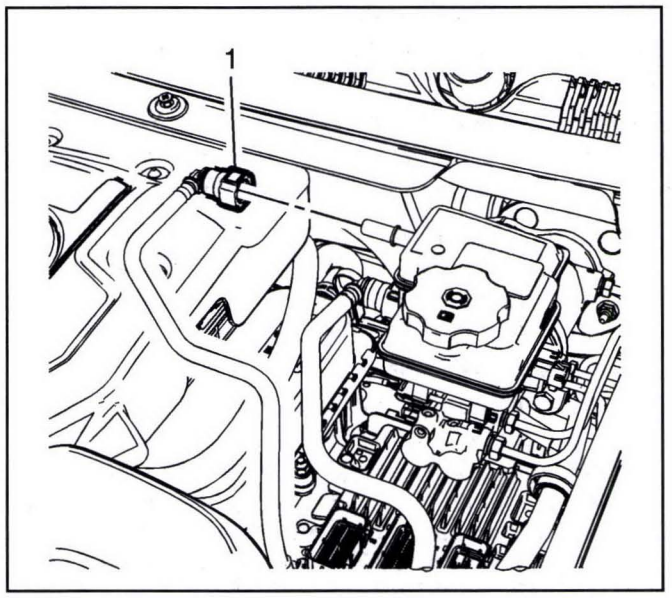
1. Place the transmission in PARK.
2. Place the power button in the OFF position.
3. Remove the remote keyless entry (RKE) transmitter and close all of the vehicle doors.

   Note: During the pressure relief process, the fluid level in the master cylinder reservoir will rise. Do not remove the master cylinder reservoir cap during the pressure relief process.
4. Wait approximately 3 minutes for the HPA pressure relief to occur.



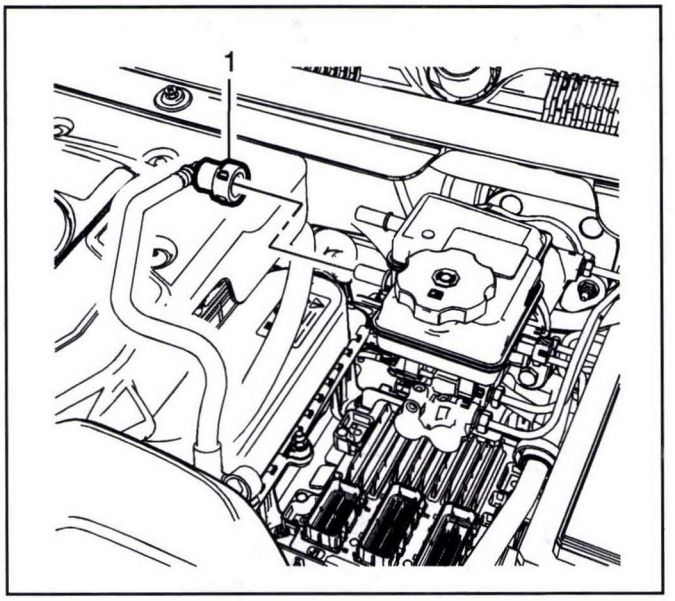
3213057

5. Remove the battery (1). Refer to *Battery Replacement on page 9-28*.
6. Remove the brake fluid from the master cylinder reservoir and discard into an approved container.
7. Disconnect the brake fluid level indicator switch electrical connector.



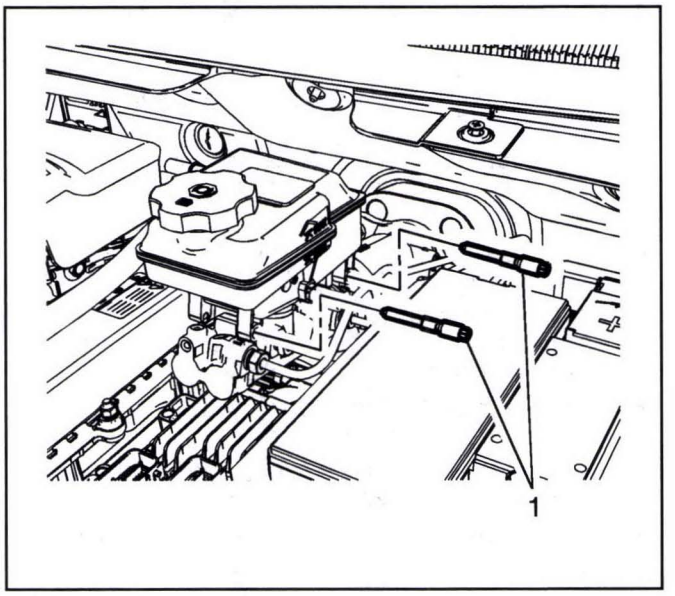
3216586

8. Disconnect the master cylinder reservoir return hose quick connect (1).



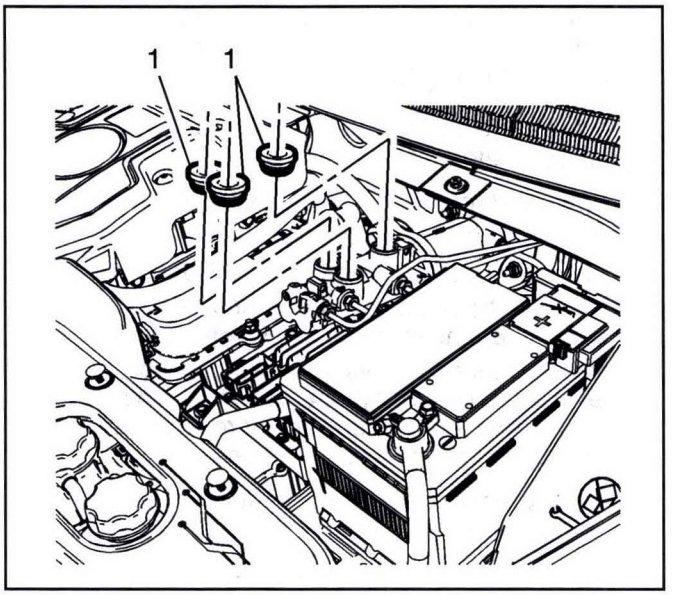
3216589

9. Disconnect the master cylinder reservoir feed hose quick connect (1).



3216590

10. Remove the master cylinder reservoir bolts (1).
11. Remove the master cylinder reservoir from the master cylinder by pulling upward.

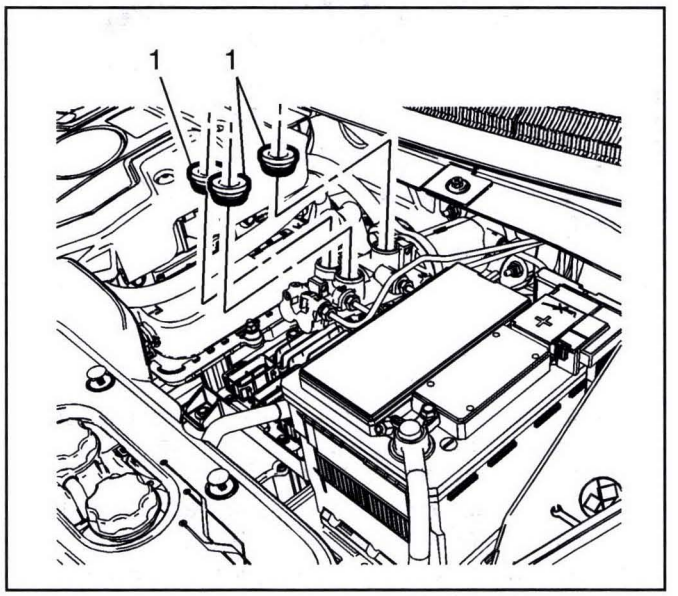


3216593

12. Remove the master cylinder reservoir seals (1).

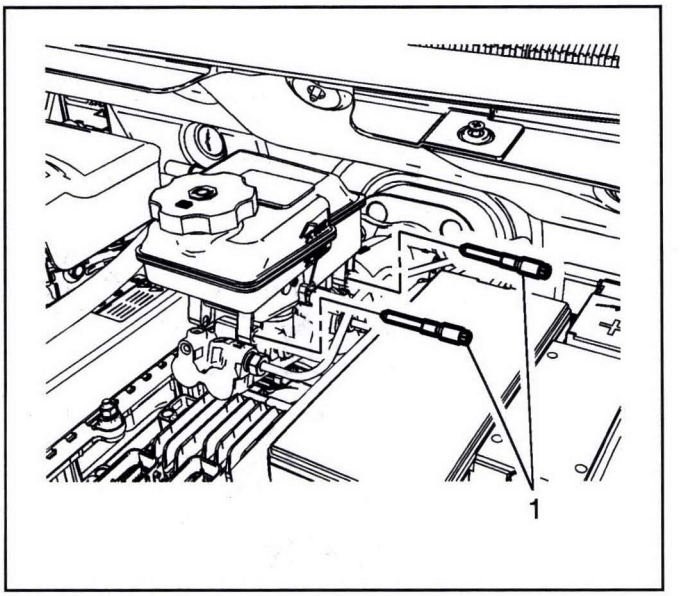
Installation Procedure

1. Lightly lubricate the master cylinder reservoir seals with GM approved brake fluid from a clean, sealed brake fluid container. Refer to *Adhesives, Fluids, Lubricants, and Sealers on page 5-133*.



3216593

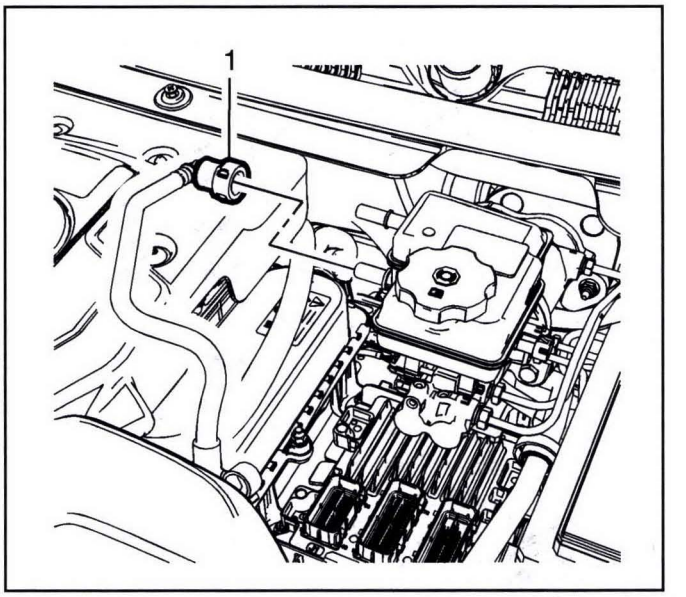
2. Install the master cylinder reservoir seals (1).
3. Carefully install the master cylinder reservoir to the master cylinder.



3216590

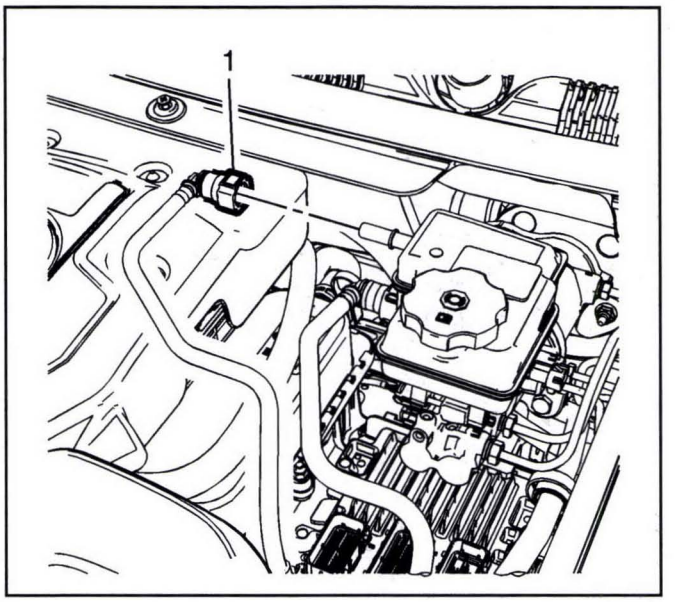
Caution: Refer to *Fastener Caution on page 0-8*.

4. Install the master cylinder reservoir bolts (1) and tighten to **8 N•m (71 lb in)**.



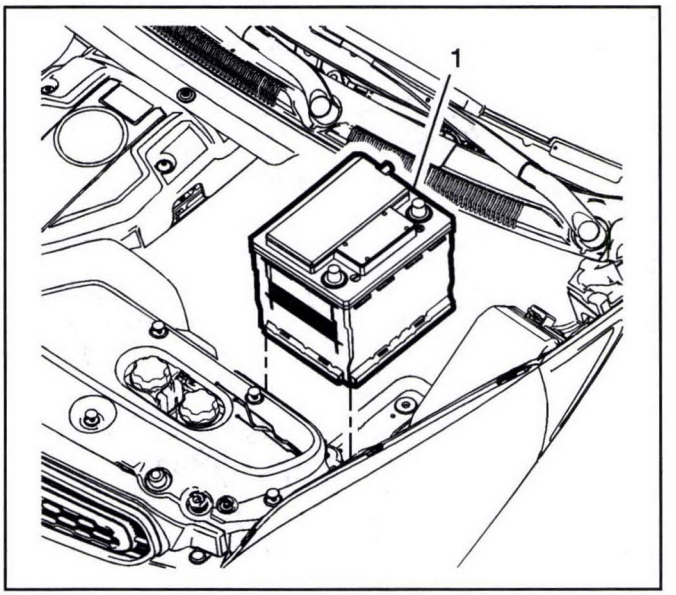
3216589

5. Connect the master cylinder reservoir feed hose quick connect (1).



3216586

6. Connect the master cylinder reservoir return hose quick connect (1).
7. Connect the brake fluid level indicator switch electrical connector.



3213057

8. Install the battery (1). Refer to *Battery Replacement on page 9-28*.
9. Fill the master cylinder reservoir. Refer to *Master Cylinder Reservoir Filling on page 5-165*.

Master Cylinder Replacement

Removal Procedure

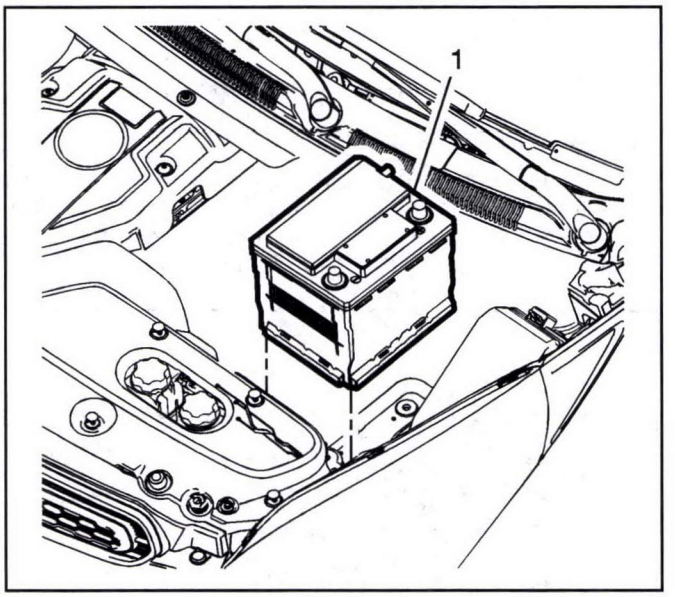
Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

Note: The transmission must be in the PARK position, the power button in the OFF position, and the brakes not applied to ensure the brake modulator and high pressure accumulator (HPA) pressure relief occurs. This process will take approximately 1 to 3 minutes.

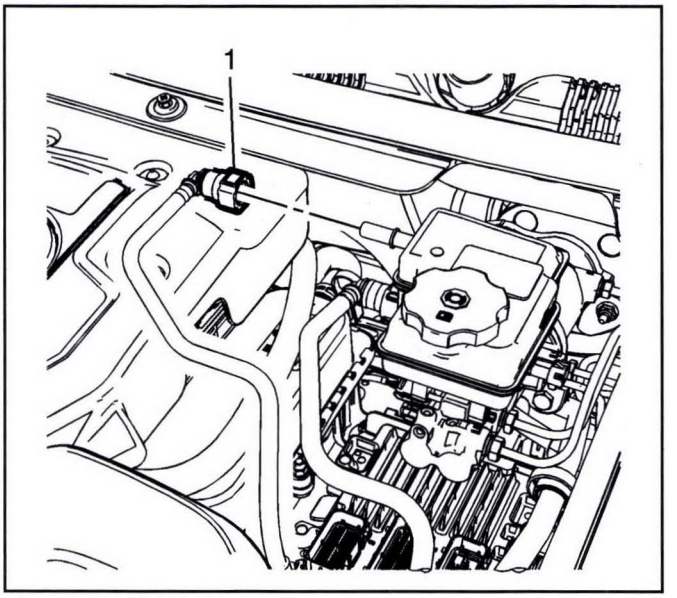
1. Apply and release the brake pedal.
2. Place the transmission in PARK.
3. Place the power button in the OFF position.
4. Remove the remote keyless entry (RKE) transmitter and close all of the vehicle doors.

   Note: During the pressure relief process, the fluid level in the master cylinder reservoir will rise. Do not remove the master cylinder reservoir cap during the pressure relief process.
5. Wait approximately 3 minutes for the HPA pressure relief to occur.



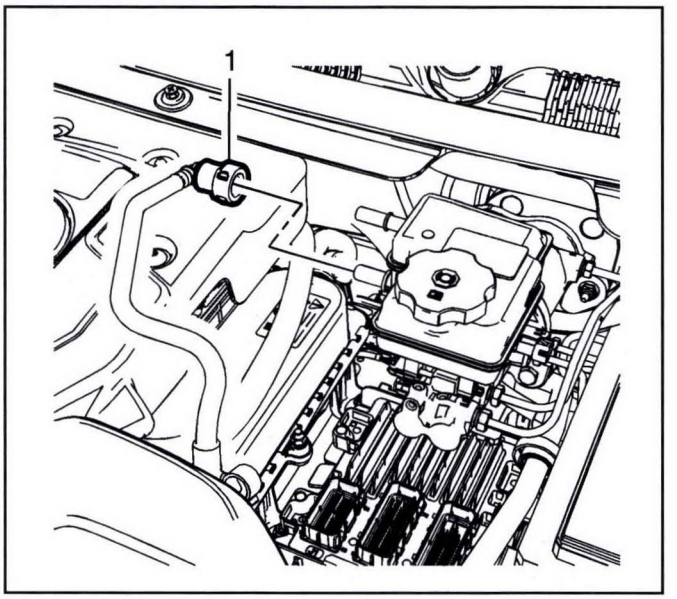
3213057

6. Remove the battery (1). Refer to *Battery Replacement on page 9-28*.
7. Place a clean shop cloth under the brake master cylinder to absorb any brake fluid when disconnecting the brake pipe fitting.
8. Remove the brake fluid from the master cylinder reservoir and discard into an approved container.
9. Disconnect the brake fluid level indicator switch electrical connector.



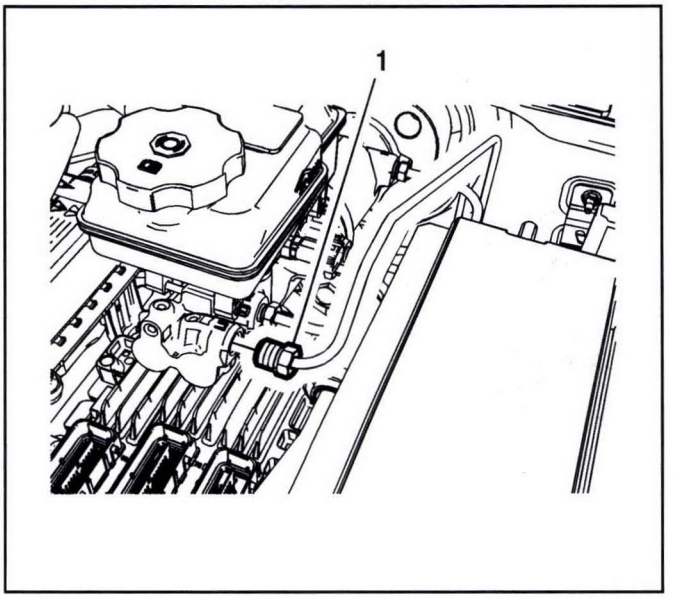
3216586

10. Disconnect the brake pressure modulator valve (BPMV) return hose quick connect (1).



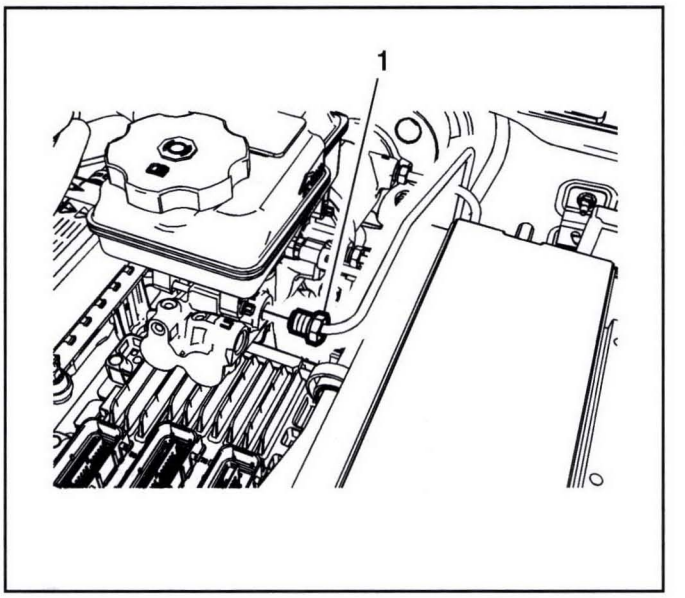
3216589

11. Disconnect the BPMV feed hose quick connect (1).



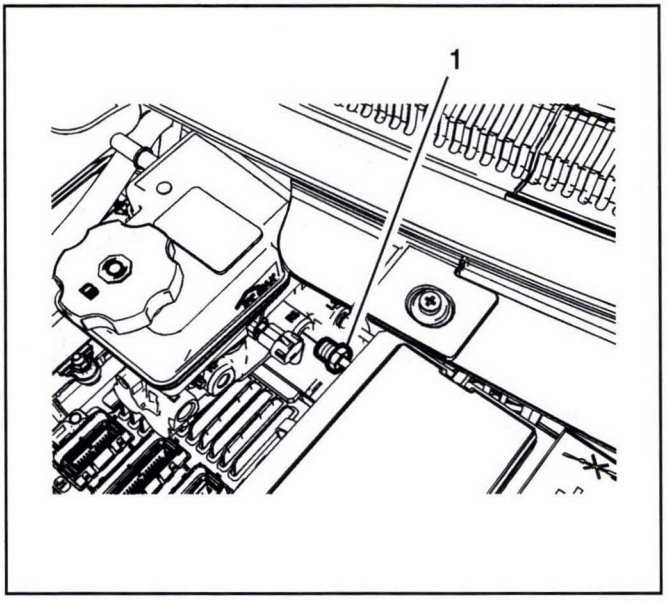
3217043

12. Disconnect the left front brake pipe fitting (1) from the master cylinder.
13. Cap the brake pipe fitting and plug the master cylinder outlet port to prevent brake fluid loss and contamination.



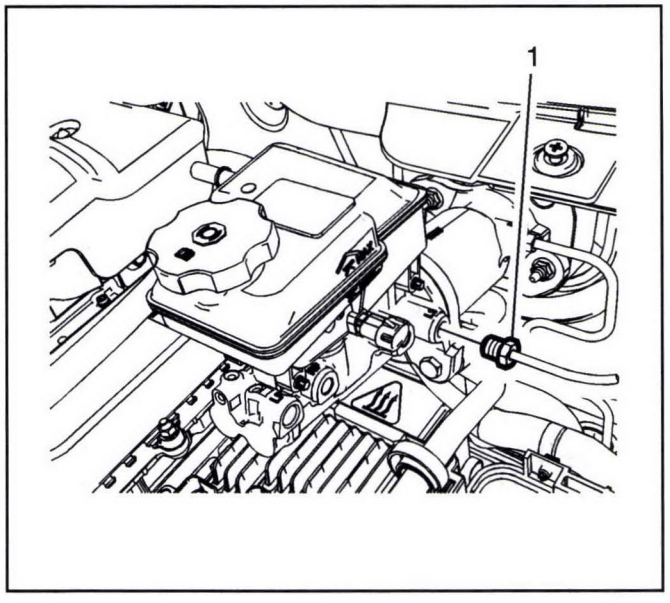
3217046

14. Disconnect the right front brake pipe fitting (1) from the master cylinder.
15. Cap the brake pipe fitting and plug the master cylinder outlet port to prevent brake fluid loss and contamination.



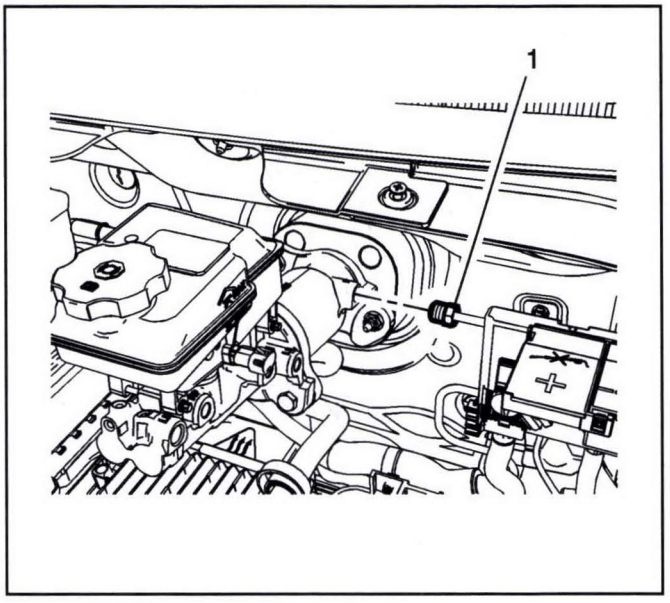
3217048

16. Disconnect the BPMV rear brake pipe fitting (1) from the master cylinder.
17. Cap the brake pipe fitting and plug the master cylinder outlet port to prevent brake fluid loss and contamination.



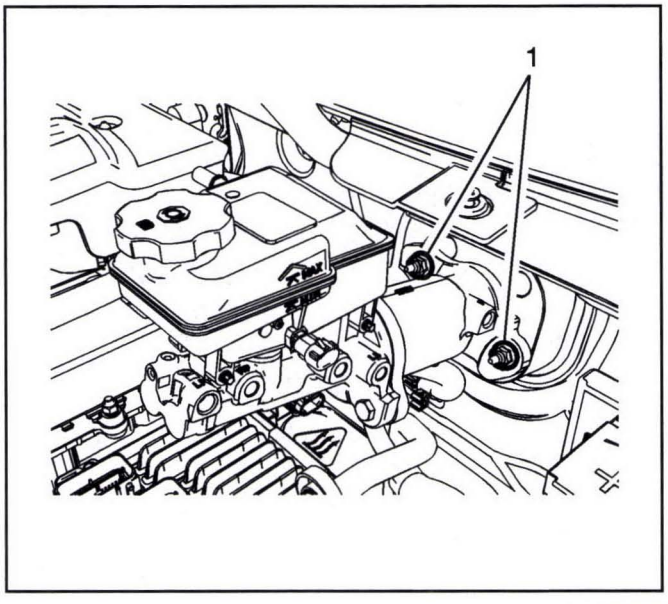
3217049

18. Disconnect the BPMV front brake pipe fitting (1) from the master cylinder.
19. Cap the brake pipe fitting and plug the master cylinder outlet port to prevent brake fluid loss and contamination.



3217050

20. Disconnect the BPMV brake pipe fitting (1) from the master cylinder.
21. Cap the brake pipe fitting and plug the master cylinder outlet port to prevent brake fluid loss and contamination.



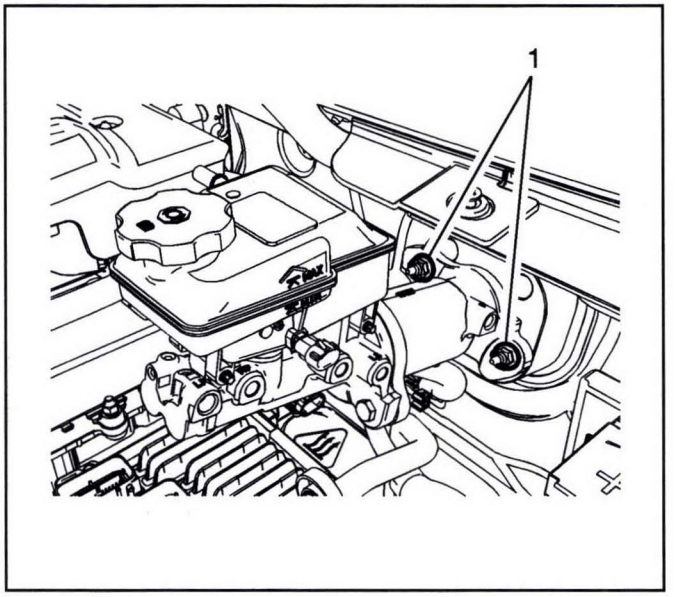
3217052

Note: Do not reuse the master cylinder nuts.

22. Remove and discard the master cylinder nuts (1).
23. Remove the brake master cylinder.

Installation Procedure

1. Install the brake master cylinder to the vehicle.

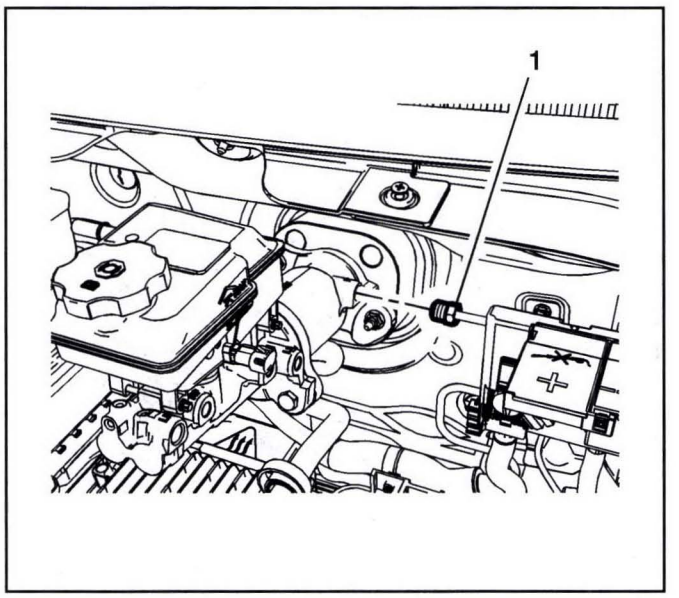


3217052

Caution: Refer to *Fastener Caution on page 0-8*.

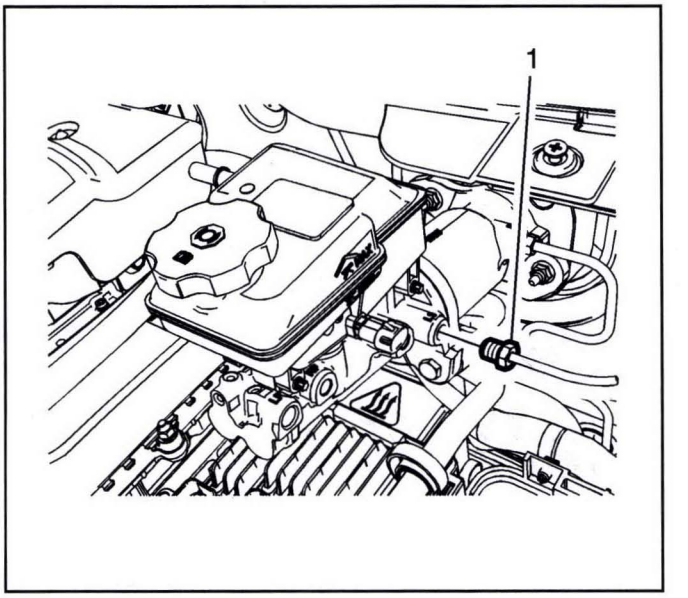
Note: Install new master cylinder nuts.

2. Install 2 new master cylinder nuts (1) and tighten to **25** N•m **(18 lb ft)**.



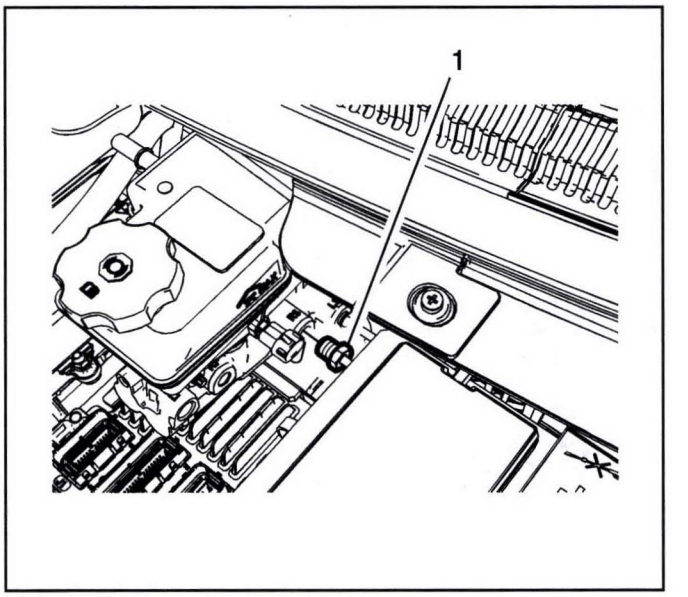
3217050

3. Install the BPMV brake pipe fitting (1) to the master cylinder and tighten the brake pipe fitting nut to **18** N•m **(13 lb ft)**.



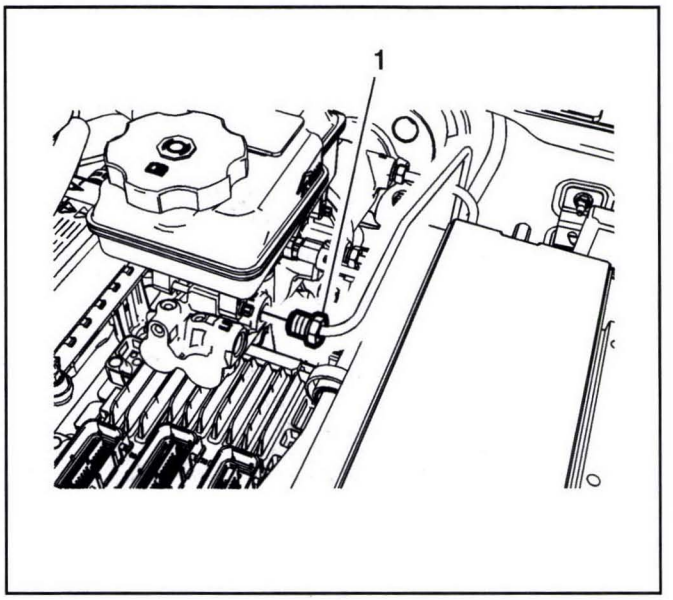
3217049

4. Install the BPMV front brake pipe fitting (1) to the master cylinder and tighten the brake pipe fitting nut to **18** N•m **(13 lb ft)**.



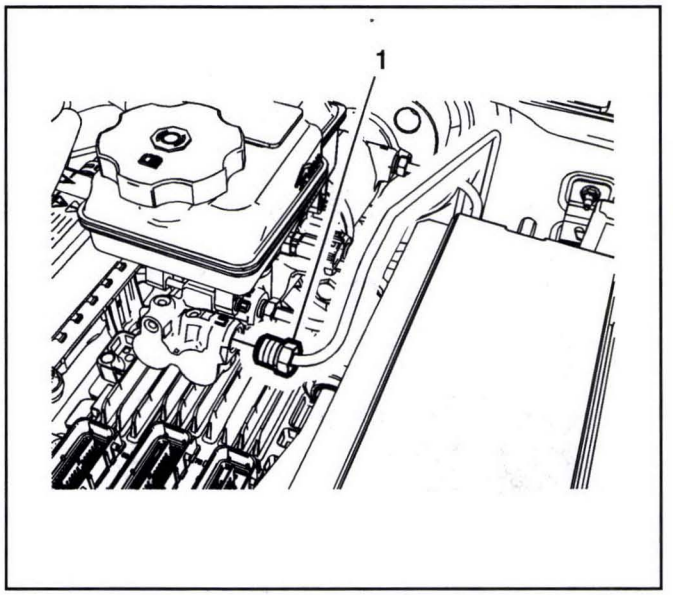
3217048

5. Install the BPMV rear brake pipe fitting (1) to the master cylinder and tighten the brake pipe fitting nut to **18** N•m **(13 lb ft)**.



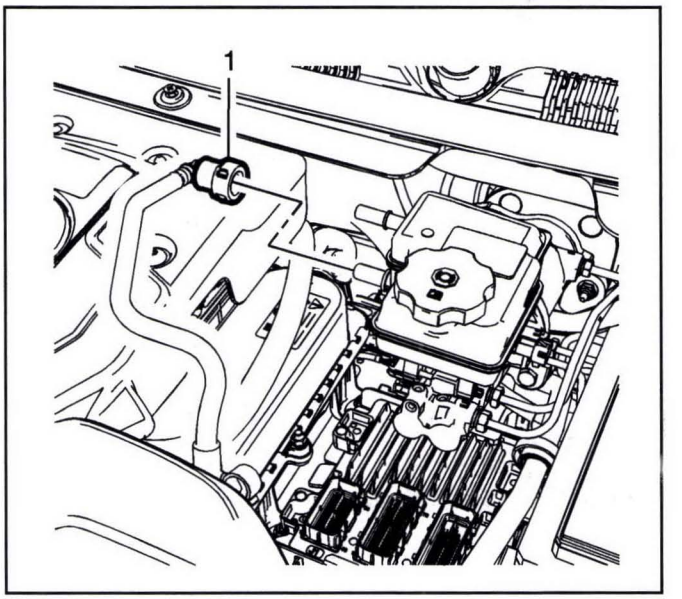
3217046

6. Install the right front brake pipe fitting (1) to the master cylinder and tighten the brake pipe fitting nut to **18 N•m (13 lb ft)**.



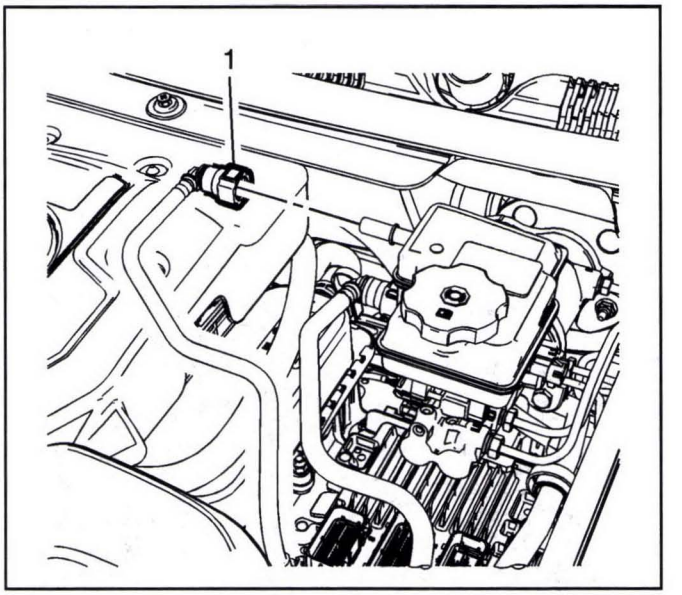
3217043

7. Install the left front brake pipe fitting (1) to the master cylinder and tighten the brake pipe fitting nut to **18 N•m (13 lb ft)**.



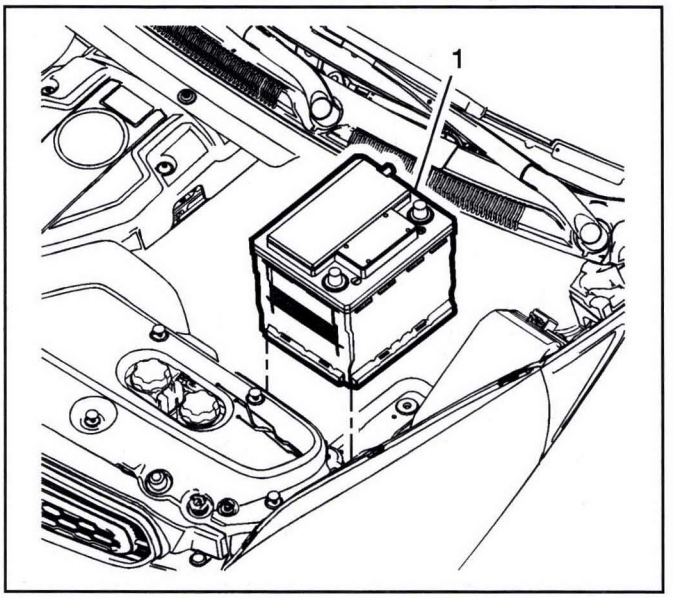
3216589

8. Connect the BPMV feed hose quick connect (1).



3216586

9. Connect the BPMV return hose quick connect (1).
10. Connect the brake fluid level indicator switch electrical connector.



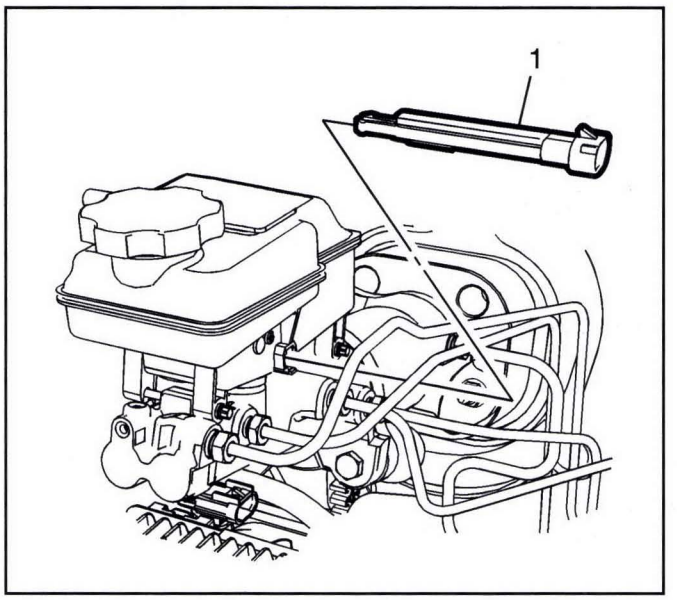
3213057

11. Install the battery (1). Refer to *Battery Replacement on page 9-28*.
12. Fill the master cylinder reservoir. Refer to *Master Cylinder Reservoir Filling on page 5-165*.
13. Bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*.

Brake Fluid Level Indicator Switch Replacement

Removal Procedure

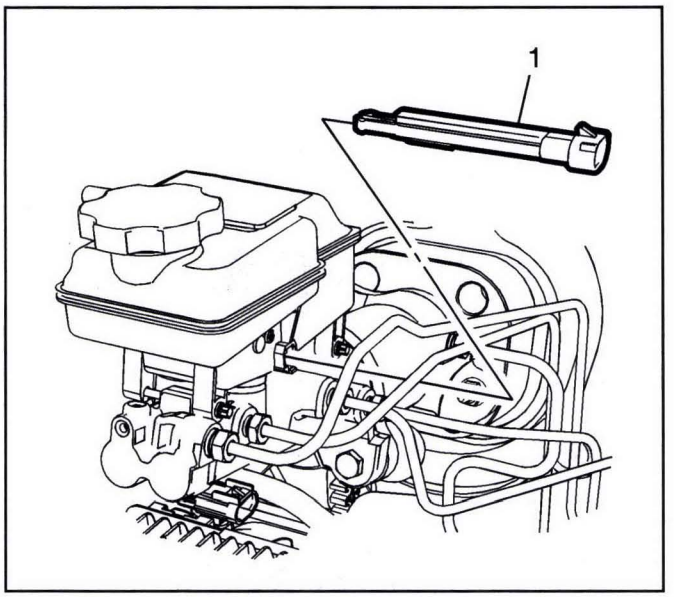
1. Remove the battery. Refer to *Battery Replacement on page 9-28*.
2. Disconnect the brake fluid level indicator switch electrical connector.



3217305

3. Compress the brake fluid level indicator switch locking tabs on the inboard side of the master cylinder reservoir.
4. Remove the brake fluid level indicator switch (1).

Installation Procedure



3217305

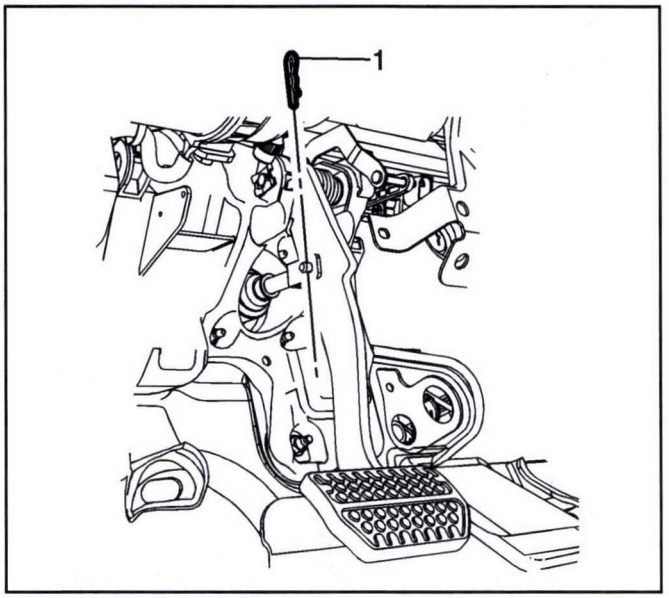
Note: Ensure the brake fluid level indicator switch locking tabs are fully engaged in the master cylinder reservoir.

1. Install the brake fluid level indicator switch (1) to the master cylinder reservoir.
2. Connect the brake fluid level indicator switch electrical connector.
3. Install the battery. Refer to *Battery Replacement on page 9-28*.

Brake and Accelerator Pedal Assembly Replacement

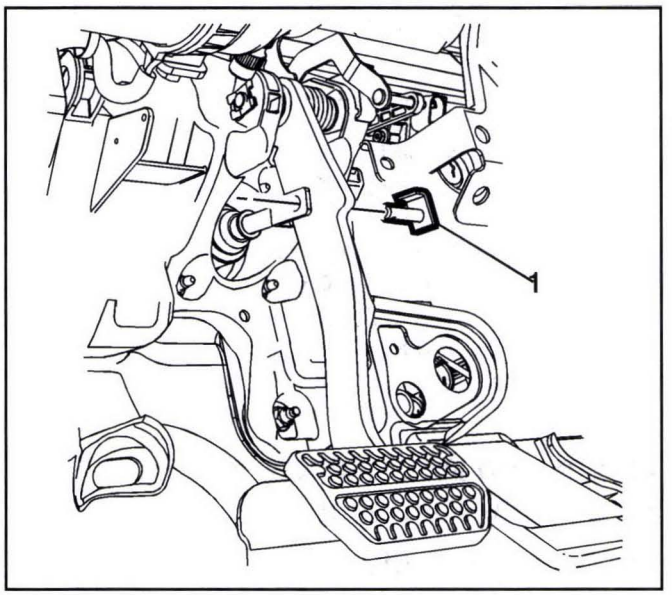
Removal Procedure

1. Remove the brake pedal position sensor. Refer to *Brake Pedal Position Sensor Replacement (Travel Sensor) on page 4-170* or *Brake Pedal Position Sensor Replacement (Apply Sensor) on page 4-171*.
2. Remove the steering column. Refer to *Steering Column Replacement on page 14-34*.
3. Remove the intermediate steering shaft. Refer to *Intermediate Steering Shaft Replacement on page 14-28*.
4. Disconnect the brake pedal travel sensor electrical connector.
5. Disconnect the accelerator pedal position sensor electrical connector.



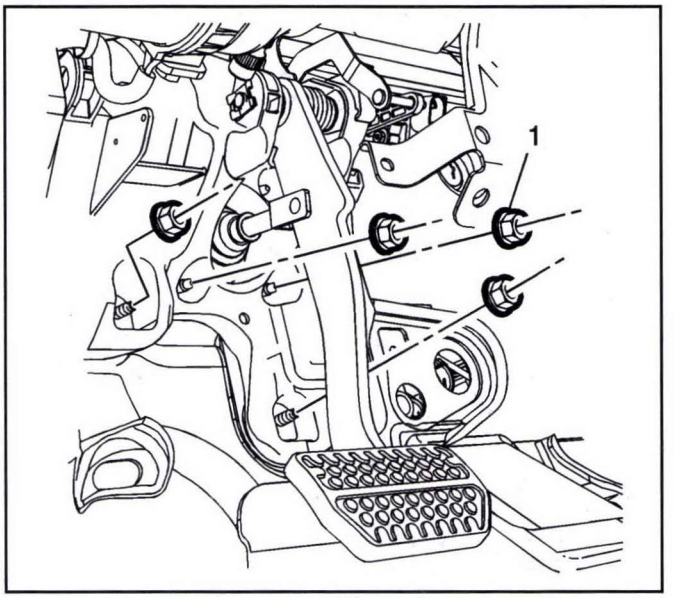
3217538

6. Remove the brake pedal clevis pin clip (1).



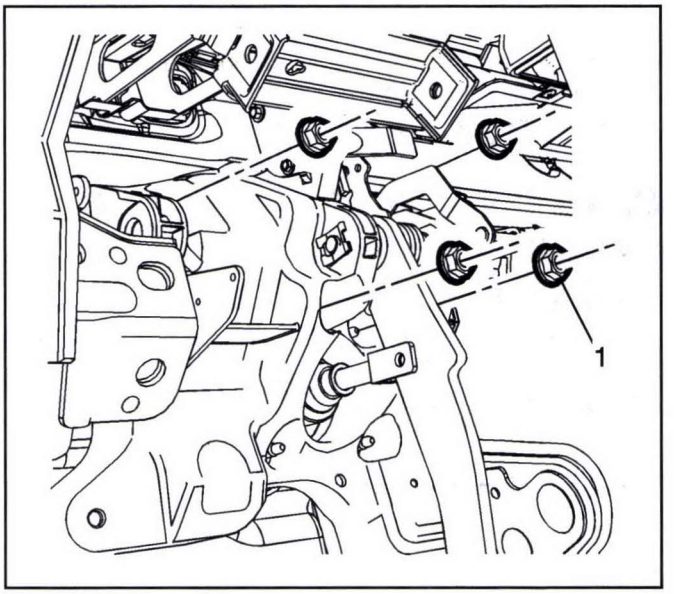
3217541

7. Remove the brake pedal clevis pin (1).



3217542

8. Remove the brake and accelerator pedal assembly lower nuts (1).

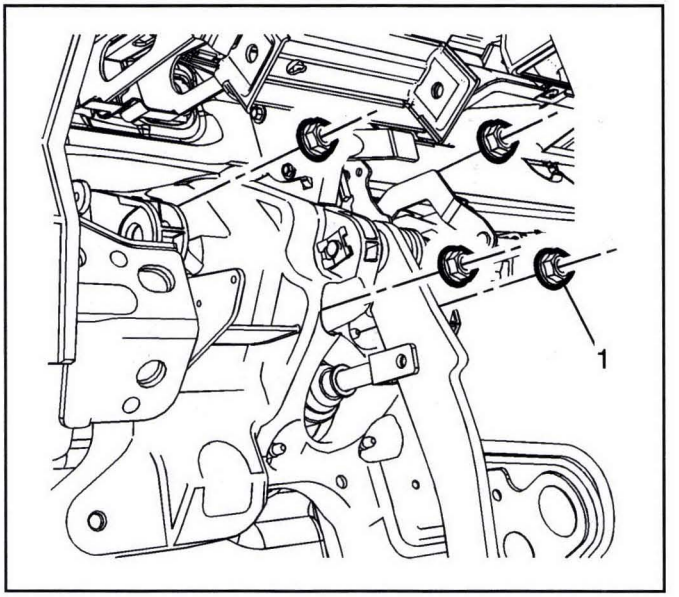


3217543

9. Remove the brake and accelerator pedal assembly upper nuts (1).
10. Remove the brake and accelerator pedal assembly.

Installation Procedure

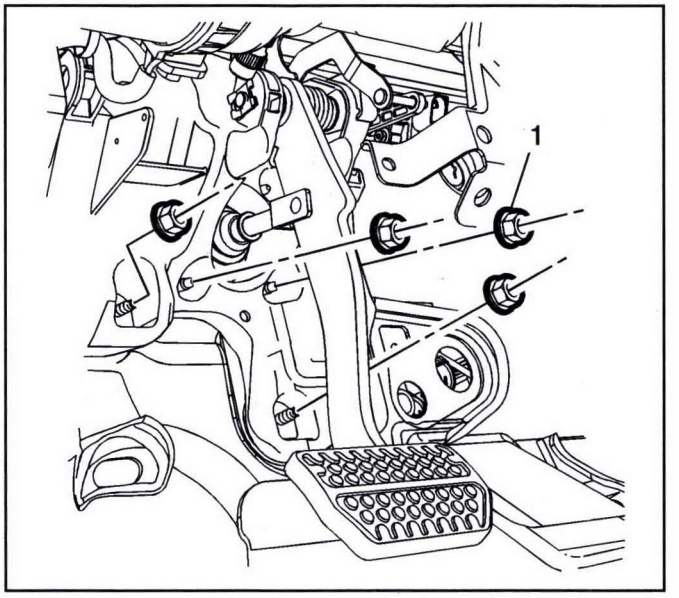
1. Install the brake and accelerator pedal assembly.



3217543

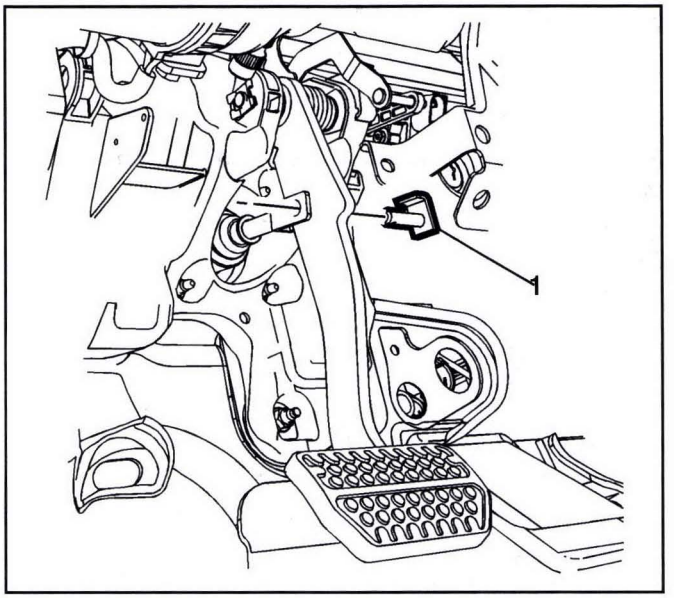
Caution: Refer to *Fastener Caution on page 0-8*.

2. Install the brake and accelerator pedal assembly upper nuts (1) and tighten the nuts to **22** N•m **(16 lb ft)**.



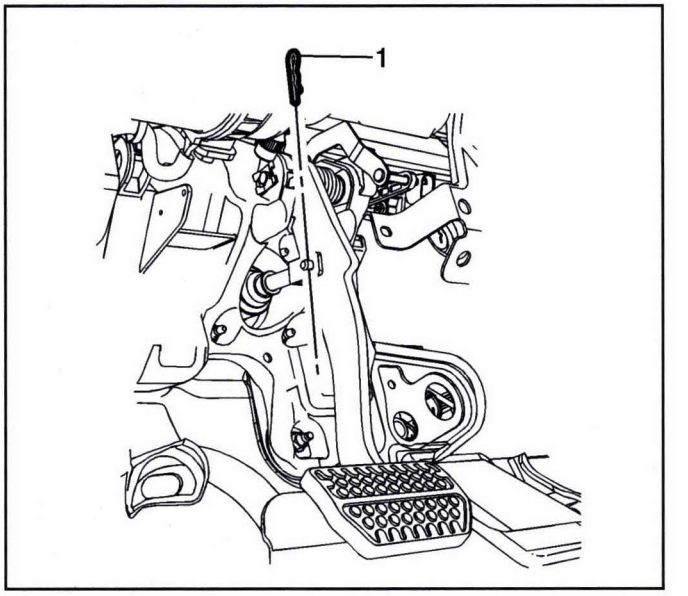
3217542

3. Install the brake and accelerator pedal assembly lower nuts (1) and tighten the nuts to **22** N•m **(16 lb ft)**.



3217541

4. Install the brake pedal clevis pin (1).



3217538

5. Install the brake pedal clevis pin clip (1).
6. Connect the accelerator pedal position sensor electrical connector.
7. Connect the brake pedal travel sensor electrical connector.
8. Connect the brake pedal position sensor electrical connector.
9. Install the intermediate steering shaft. Refer to *Intermediate Steering Shaft Replacement on page 14-28*.
10. Install the steering column. Refer to *Steering Column Replacement on page 14-34*.
11. Install the brake pedal position sensor. Refer to *Brake Pedal Position Sensor Replacement (Travel Sensor) on page 4-170* or *Brake Pedal Position Sensor Replacement (Apply Sensor) on page 4-171*.

Brake Pressure Modulator Valve Hose Replacement

Removal Procedure

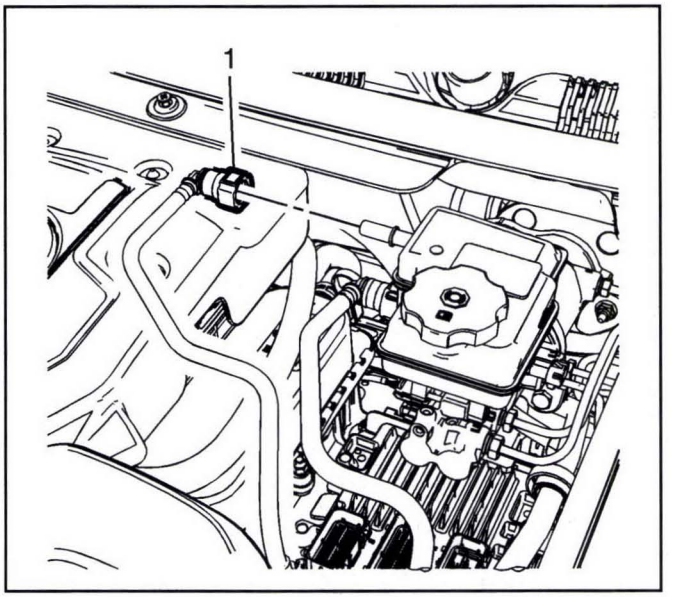
Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7.*

Note: The transmission must be in the PARK position, the power button in the OFF position, and the brakes not applied to ensure the brake modulator and high pressure accumulator (HPA) pressure relief occurs. This process will take approximately 1 to 3 minutes.

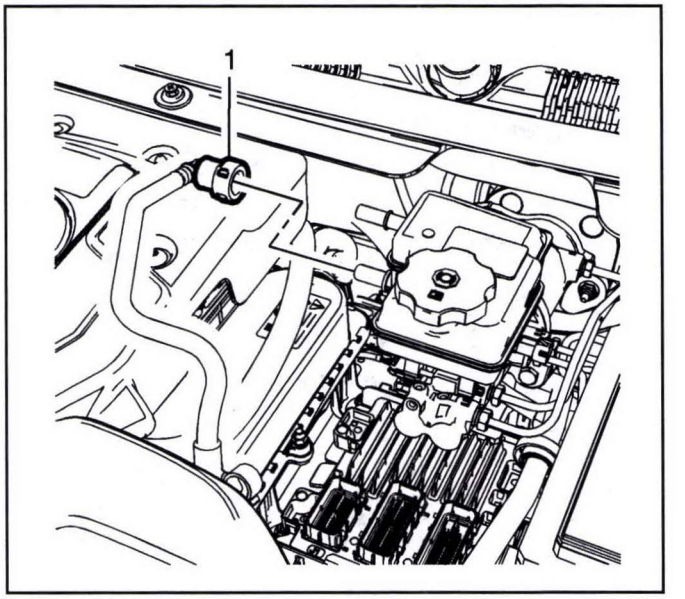
1. Place the transmission in PARK.
2. Place the power button in the OFF position.
3. Remove the remote keyless entry (RKE) transmitter and close all of the vehicle doors.

   Note: During the pressure relief process, the fluid level in the master cylinder reservoir will rise. Do not remove the master cylinder reservoir cap during the pressure relief process.
4. Wait approximately 3 minutes for the HPA pressure relief to occur.
5. Remove and properly dispose of the brake fluid in the brake master cylinder reservoir.



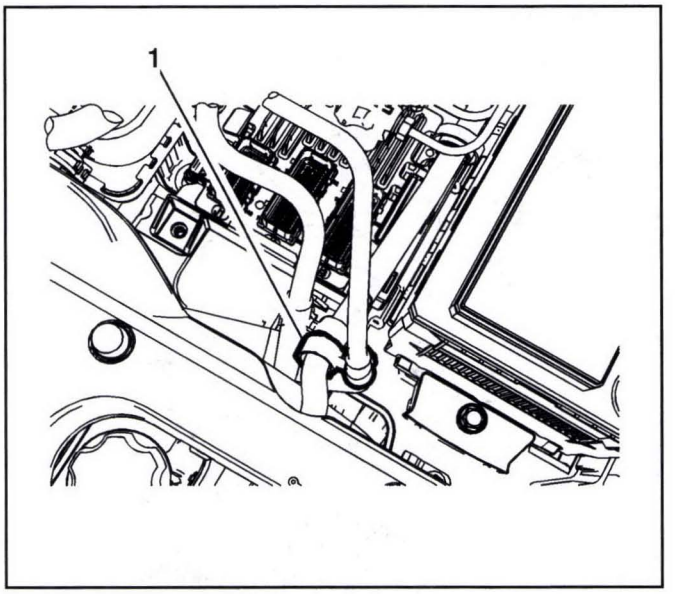
3216586

6. Disconnect the brake pressure modulator valve return hose quick connect (1).



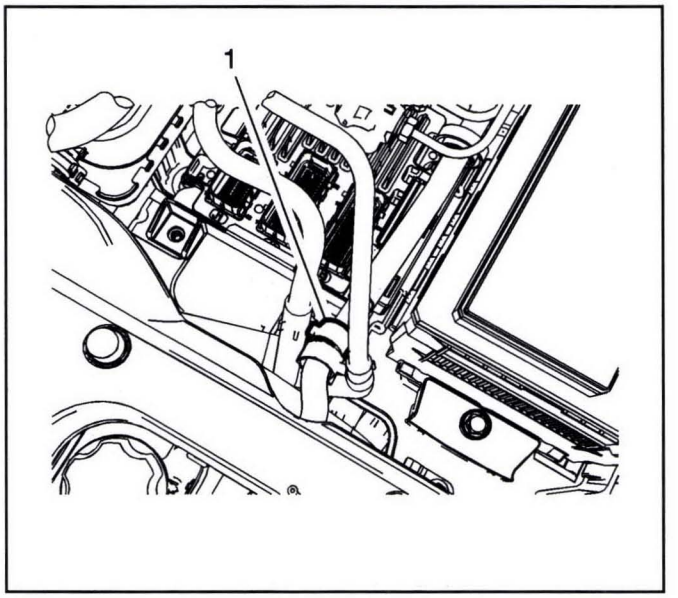
3216589

7. Disconnect the brake pressure modulator valve feed hose quick connect (1).



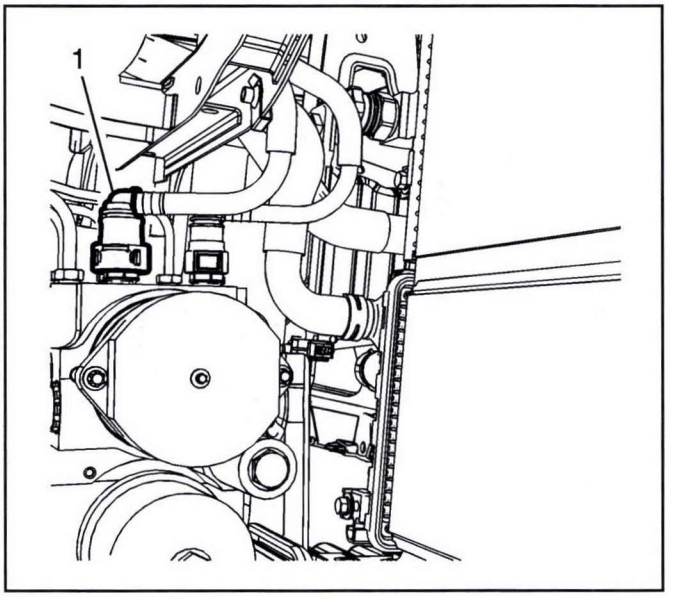
3220244

8. Release the brake pressure modulator valve return hose clip (1) from the differential drive motor cooling hose.



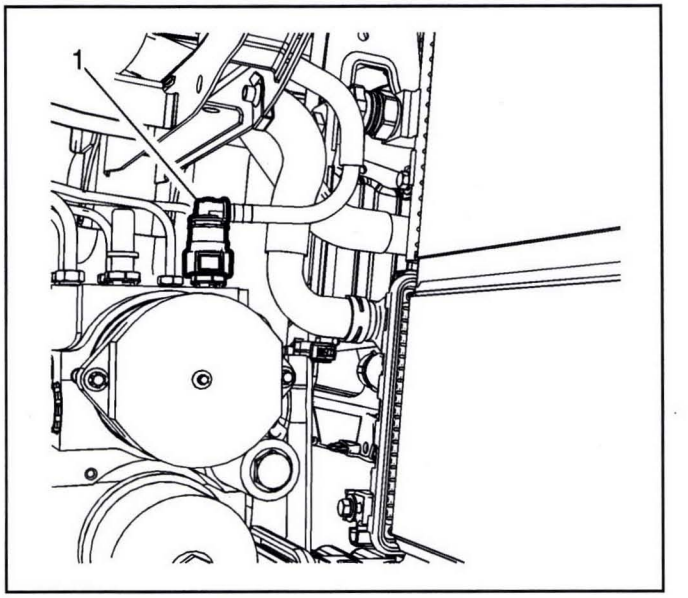
3220254

9. Release the brake pressure modulator valve feed hose clip (1) from the differential drive motor cooling hose.
10. Remove the cooling fan and shroud. Refer to *Cooling Fan and Shroud Replacement on page 9-283*.



3349829

11. Disconnect the brake pressure modulator valve feed hose quick connect (1).
12. Cap the brake pressure modulator valve inlet port to prevent brake fluid loss and contamination.

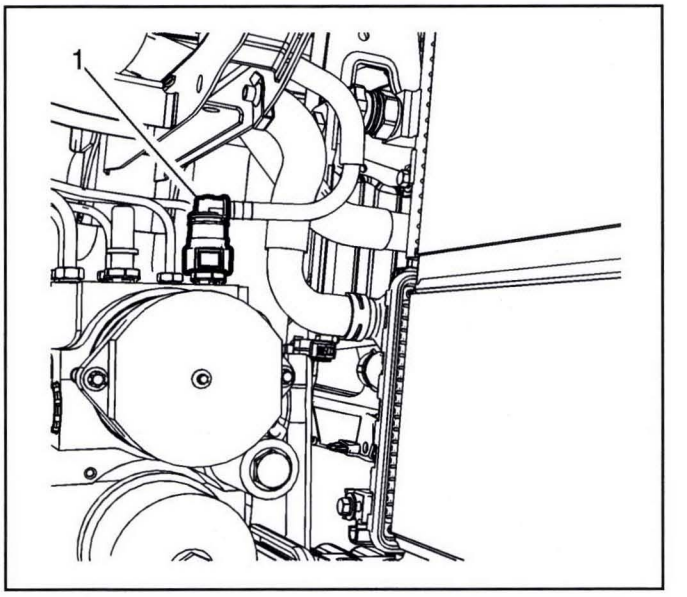


3349831

13. Disconnect the brake pressure modulator valve return hose quick connect (1).
14. Cap the brake pressure modulator valve outlet port to prevent brake fluid loss and contamination.
15. Remove the brake pressure modulator valve hoses.

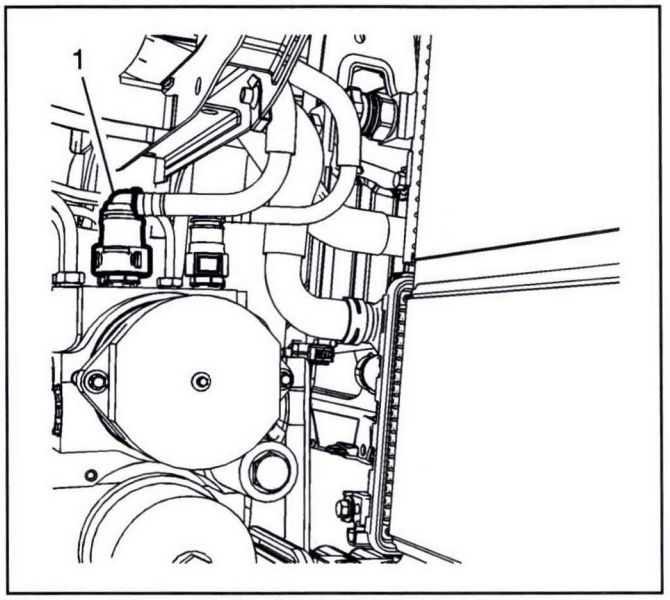
Installation Procedure

1. Install the brake pressure modulator valve hoses.



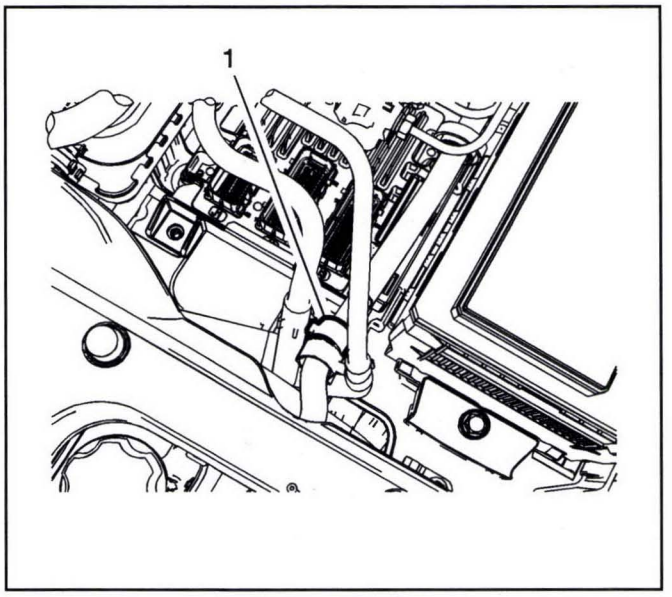
3349831

2. Connect the brake pressure modulator valve return hose quick connect (1).



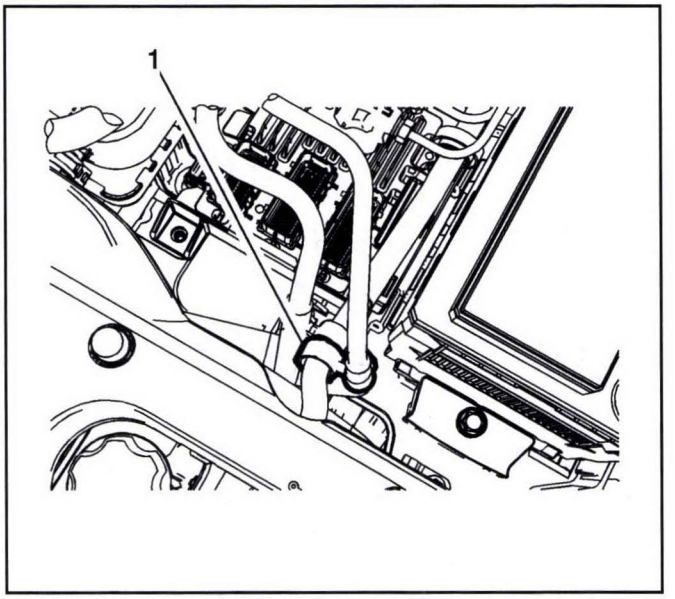
3349829

3. Connect the brake pressure modulator valve feed hose quick connect (1).
4. Install the cooling fan and shroud. Refer to *Cooling Fan and Shroud Replacement on page 9-283.*



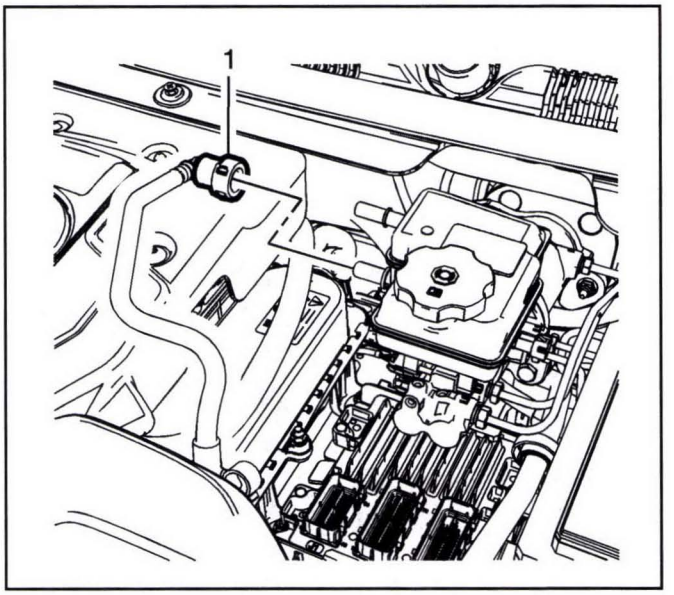
3220254

5. Install the brake pressure modulator valve feed hose clip (1) to the differential drive motor cooling hose.



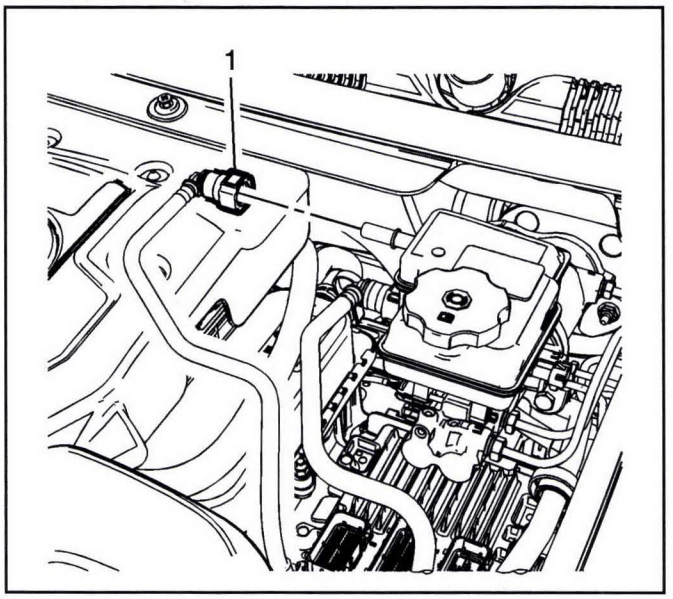
3220244

6. Install the brake pressure modulator valve return hose clip (1) to the differential drive motor cooling hose.

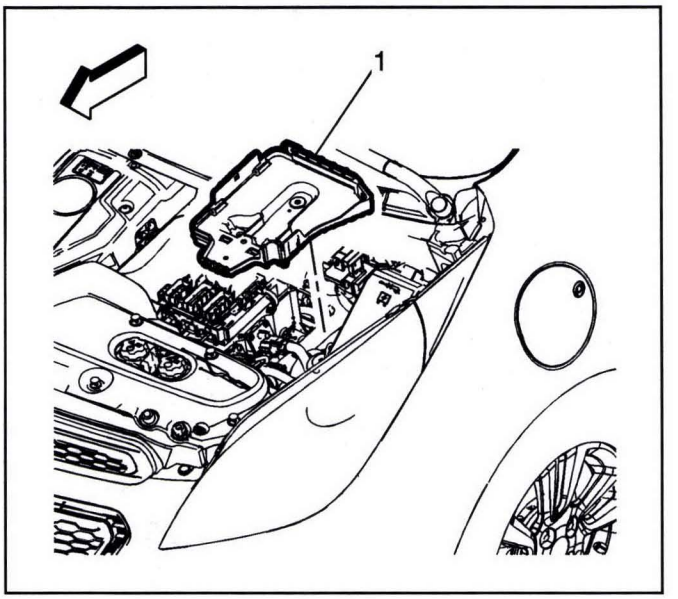


3216589

7. Connect the brake pressure modulator valve feed hose quick connect (1).



3216586



3216630

8. Connect the brake pressure modulator valve return hose quick connect (1).
9. Fill the master cylinder reservoir. Refer to *Master Cylinder Reservoir Filling on page 5-165*.

Brake Pressure Modulator Valve Pipe Replacement

Removal Procedure

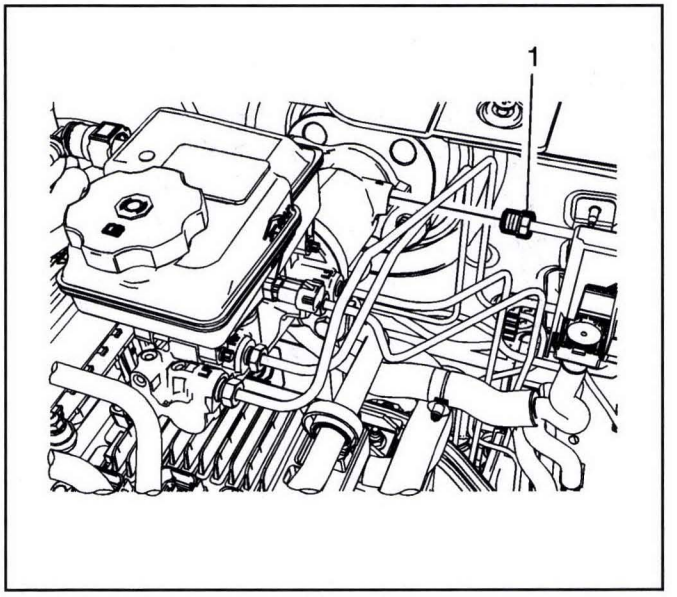
Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

Note: The transmission must be in the PARK position, the power button in the OFF position, and the brakes not applied to ensure the brake modulator and high pressure accumulator (HPA) pressure relief occurs. This process will take approximately 1 to 3 minutes.

1. Place the transmission in PARK.
2. Place the power button in the OFF position.
3. Remove the remote keyless entry (RKE) transmitter and close all of the vehicle doors.

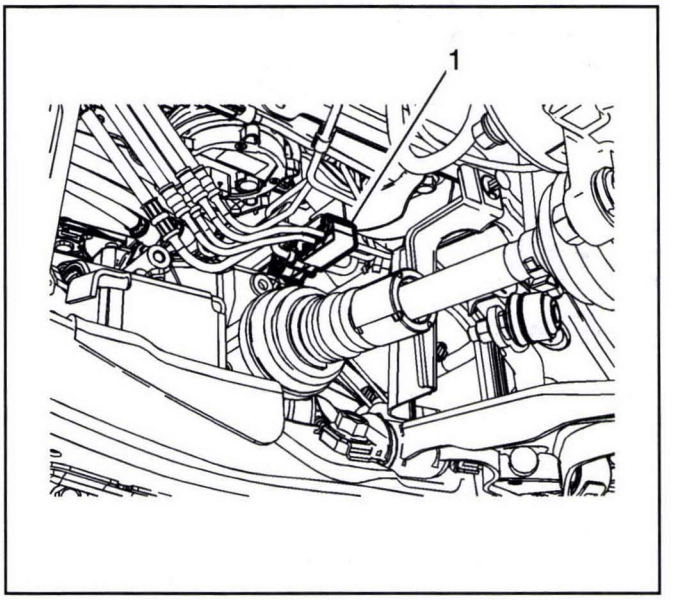
   Note: During the pressure relief process, the fluid level in the master cylinder reservoir will rise. Do not remove the master cylinder reservoir cap during the pressure relief process.
4. Wait approximately 3 minutes for the HPA pressure relief to occur.
5. Remove the battery tray (1). Refer to *Battery Tray Replacement on page 9-30*.
6. Remove the heater coolant pump. Refer to *Heater Coolant Pump Replacement on page 10-56*.
7. Remove the front bumper impact bar. Refer to *Front Bumper Fascia Replacement on page 3-57*.
8. Remove the drive motor coolant radiator assembly. Refer to *Drive Motor Battery Coolant Radiator Replacement on page 9-312*.
9. Place a clean shop cloth under the brake master cylinder to absorb any brake fluid when disconnecting the brake pipe fitting.



3222132

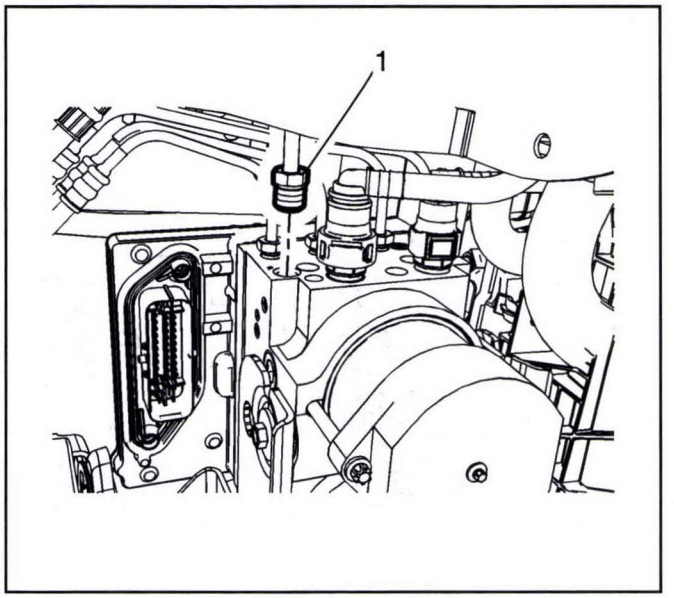
10. Disconnect the brake pressure modulator valve pipe fitting (1) from the master cylinder.
11. Plug the master cylinder port to prevent brake fluid loss and contamination.
12. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.

13. Remove the front compartment front splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.



3222137

14. Release the brake pressure modulator valve pipe from the brake pipe retainer (1).

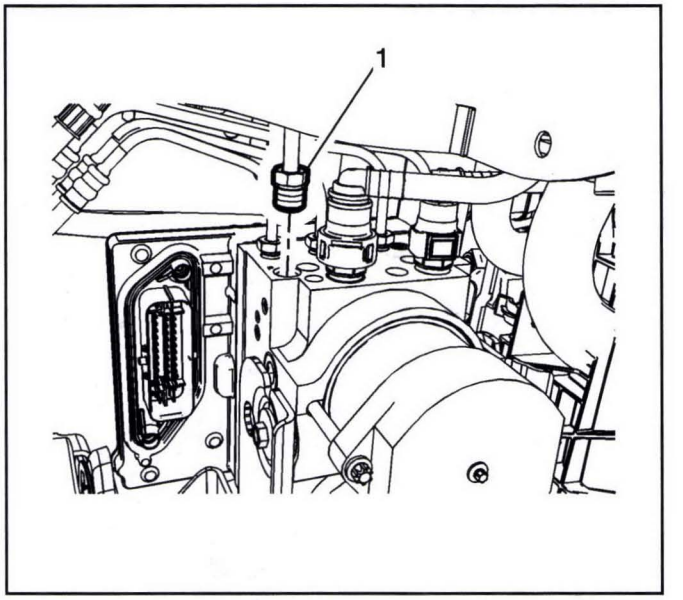


3222144

15. Disconnect the brake pressure modulator valve pipe fitting (1) from the electric hydraulic control unit (EHCU).
16. Plug the EHCU port to prevent brake fluid loss and contamination.
17. Remove the brake pressure modulator valve pipe.

Installation Procedure

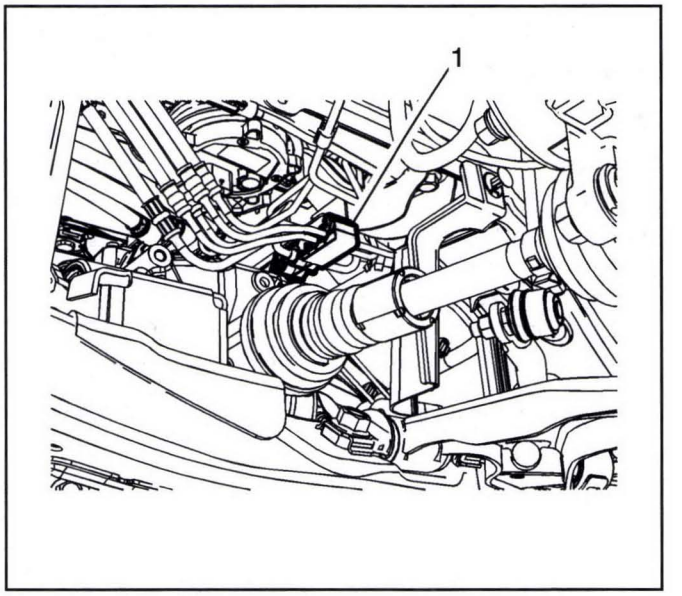
1. Install the brake pressure modulator valve pipe.



3222144

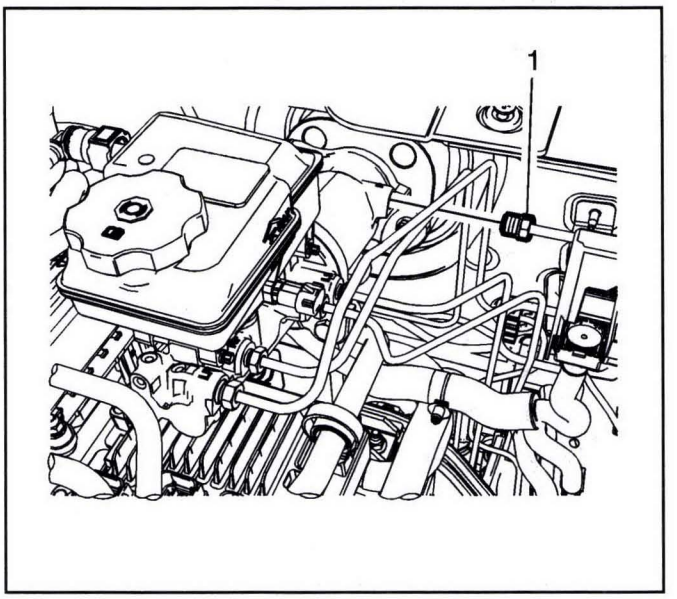
Caution: Refer to *Fastener Caution on page 0-8*.

2. Install the brake pressure modulator valve pipe fitting (1) to the EHCU and tighten the fitting to **18** N•m **(13 lb ft)**.



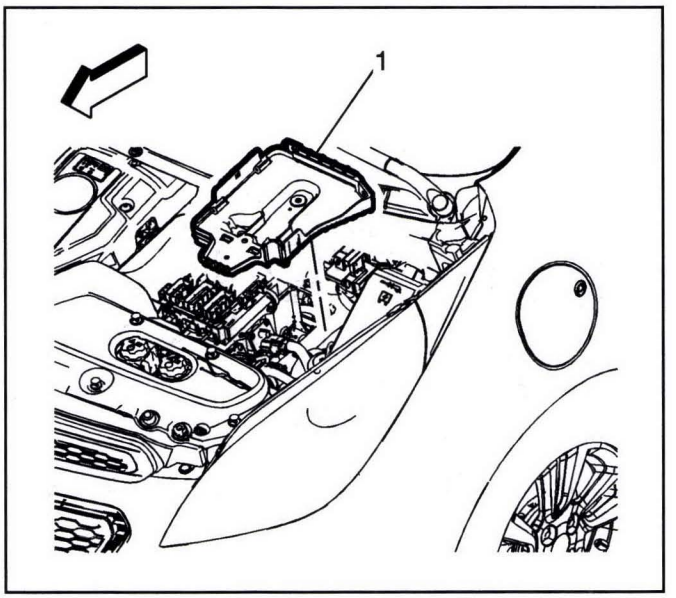
3222137

3. Secure the brake pressure modulator valve pipe to the brake pipe retainer (1).
4. Install the front compartment front splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.
5. Lower the vehicle.



3222132

6. Install the brake pressure modulator valve pipe fitting (1) to the master cylinder and tighten the fitting to **18 N•m (13 lb ft)**.
7. Install the drive motor coolant radiator assembly. Refer to *Drive Motor Battery Coolant Radiator Replacement on page 9-312*.
8. Install the front bumper impact bar. Refer to *Front Bumper Fascia Replacement on page 3-57*.
9. Install the heater coolant pump. Refer to *Heater Coolant Pump Replacement on page 10-56*.



3216630

10. Install the battery tray (1). Refer to *Battery Tray Replacement on page 9-30*.
11. Bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*.

Brake Pressure Modulator Valve Front Brake Pipe Replacement

Removal Procedure

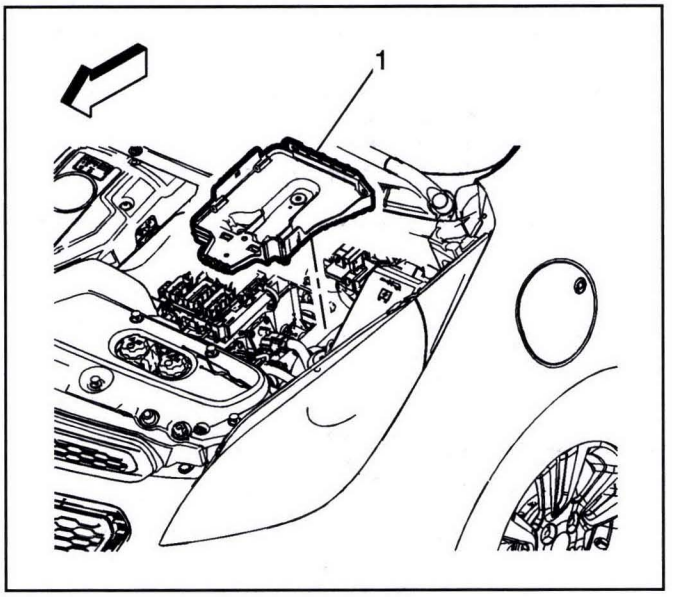
Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

Note: The transmission must be in the PARK position, the power button in the OFF position, and the brakes not applied to ensure the brake modulator and high pressure accumulator (HPA) pressure relief occurs. This process will take approximately 1 to 3 minutes.

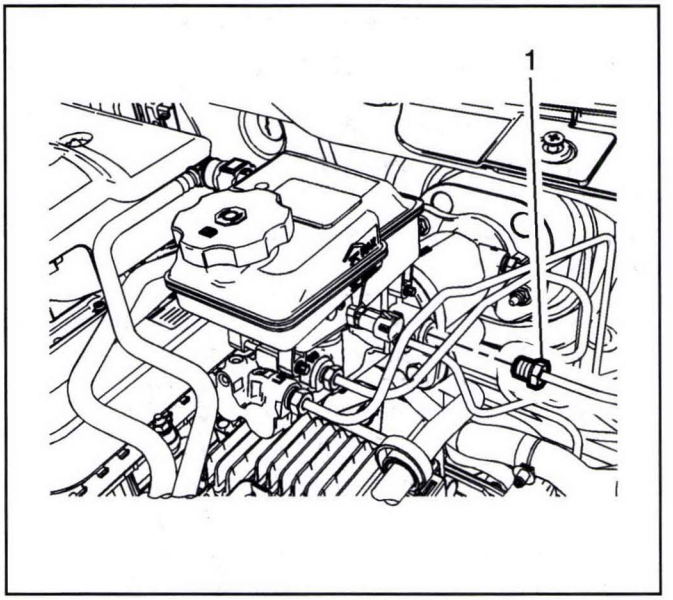
1. Place the transmission in PARK.
2. Place the power button in the OFF position.
3. Remove the remote keyless entry (RKE) transmitter and close all of the vehicle doors.

   Note: During the pressure relief process, the fluid level in the master cylinder reservoir will rise. Do not remove the master cylinder reservoir cap during the pressure relief process.
4. Wait approximately 3 minutes for the HPA pressure relief to occur.



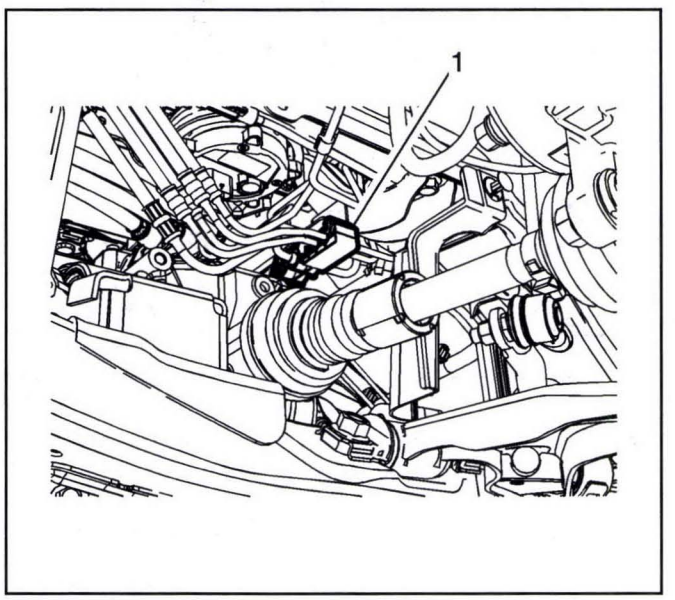
3216630

5. Remove the battery tray (1). Refer to *Battery Tray Replacement on page 9-30*.
6. Remove the heater coolant pump. Refer to *Heater Coolant Pump Replacement on page 10-56*.
7. Remove the front bumper impact bar. Refer to *Front Bumper Fascia Replacement on page 3-57*.
8. Remove the drive motor coolant radiator assembly. Refer to *Drive Motor Battery Coolant Radiator Replacement on page 9-312*.
9. Place a clean shop cloth under the brake master cylinder to absorb any brake fluid when disconnecting the brake pipe fitting.



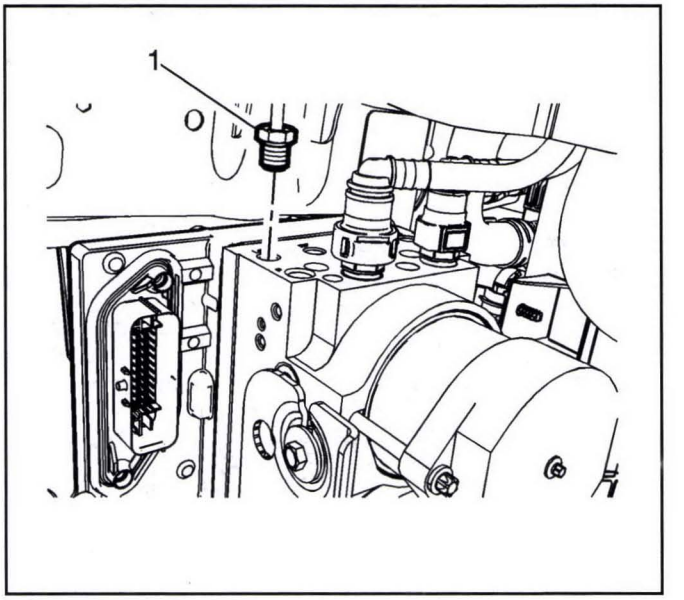
3222149

10. Disconnect the front brake pressure modulator valve pipe fitting (1) from the master cylinder.
11. Plug the master cylinder port to prevent brake fluid loss and contamination.
12. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
13. Remove the front compartment front splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.



3222137

14. Release the front brake pressure modulator valve pipe from the brake pipe retainer (1).

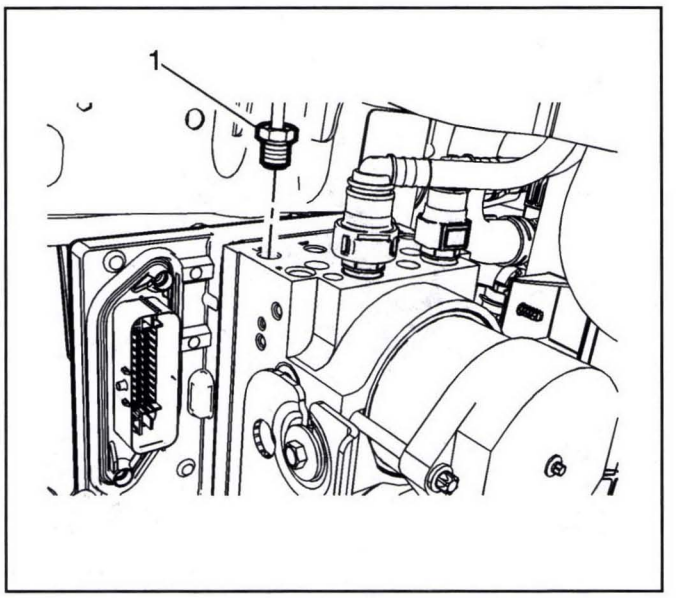


3222156

15. Disconnect the front brake pressure modulator valve pipe fitting (1) from the electric hydraulic control unit (EHCU).
16. Plug the EHCU port to prevent brake fluid loss and contamination.
17. Remove the front brake pressure modulator valve pipe.

Installation Procedure

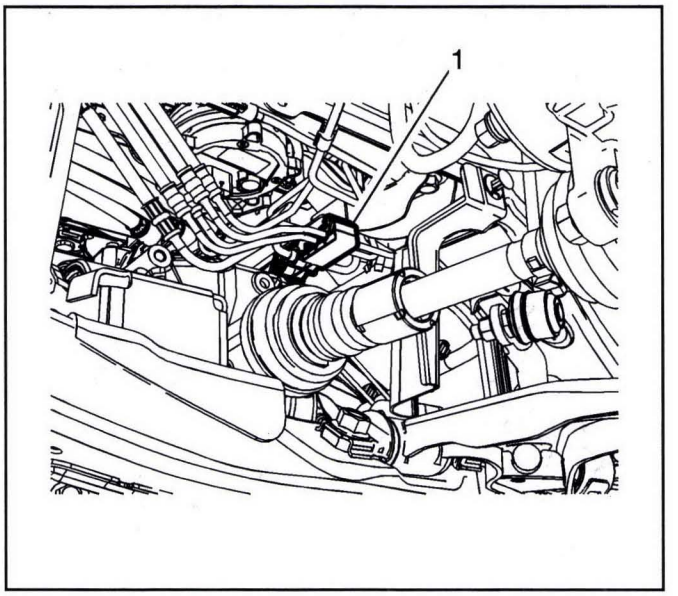
1. Install the front brake pressure modulator valve pipe.



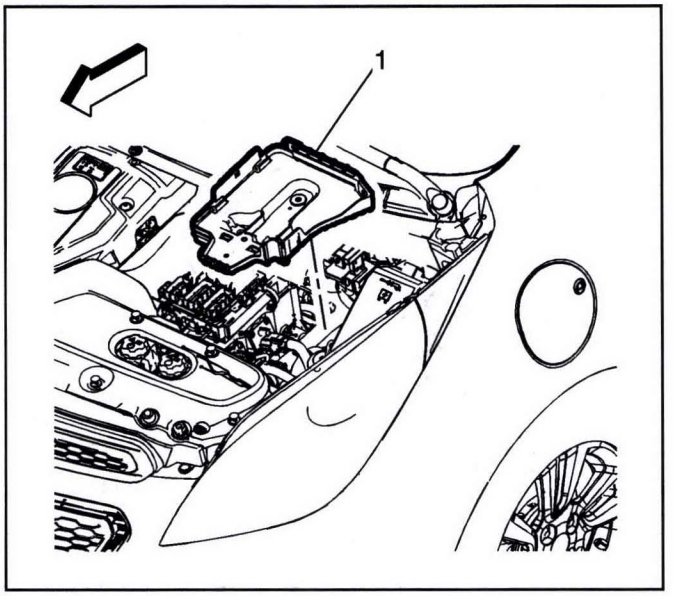
3222156

Caution: Refer to *Fastener Caution on page 0-8*.

2. Install the front brake pressure modulator valve pipe fitting (1) to the EHCU and tighten the fitting to **18** N•m **(13 lb ft)**.

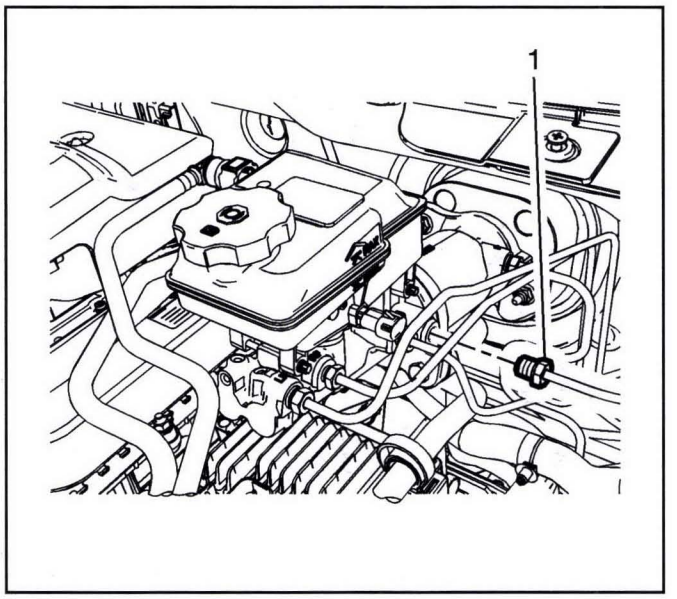


3222137



3216630

3. Secure the front brake pressure modulator valve pipe to the brake pipe retainer (1).
4. Install the front compartment front splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.
5. Lower the vehicle.



3222149

6. Install the front brake pressure modulator valve pipe fitting (1) to the master cylinder and tighten the fitting to **18 N•m (13 lb ft)**.
7. Install the drive motor coolant radiator assembly. Refer to *Drive Motor Battery Coolant Radiator Replacement on page 9-312*.
8. Install the front bumper impact bar. Refer to *Front Bumper Fascia Replacement on page 3-57*.
9. Install the heater coolant pump. Refer to *Heater Coolant Pump Replacement on page 10-56*.
10. Install the battery tray (1). Refer to *Battery Tray Replacement on page 9-30*.
11. Bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*.

Brake Pressure Modulator Valve Rear Brake Pipe Replacement

Removal Procedure

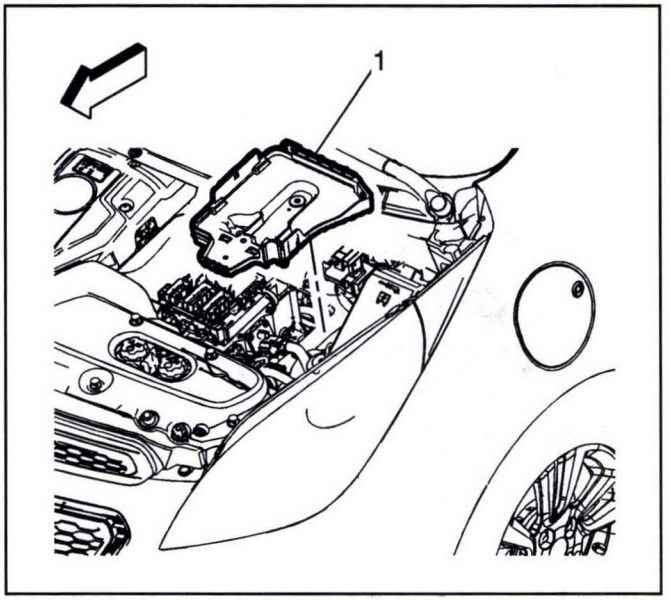
Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

Note: The transmission must be in the PARK position, the power button in the OFF position, and the brakes not applied to ensure the brake modulator and high pressure accumulator (HPA) pressure relief occurs. This process will take approximately 1 to 3 minutes.

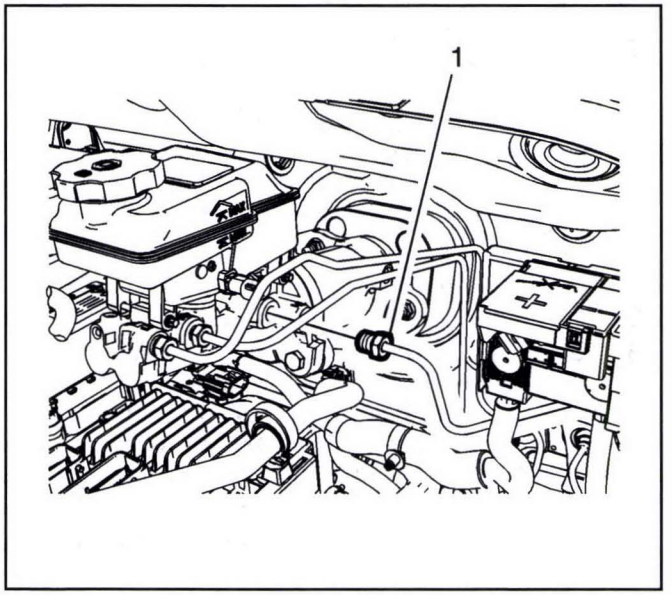
1. Place the transmission in PARK.
2. Place the power button in the OFF position.
3. Remove the remote keyless entry (RKE) transmitter and close all of the vehicle doors.

   Note: During the pressure relief process, the fluid level in the master cylinder reservoir will rise. Do not remove the master cylinder reservoir cap during the pressure relief process.
4. Wait approximately 3 minutes for the HPA pressure relief to occur.



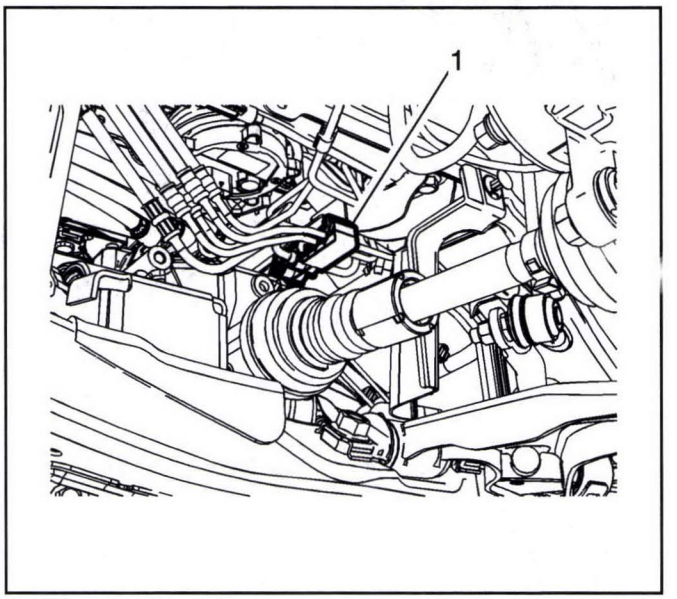
3216630

5. Remove the battery tray (1). Refer to *Battery Tray Replacement on page 9-30*.
6. Remove the heater coolant pump. Refer to *Heater Coolant Pump Replacement on page 10-56*.
7. Remove the front bumper impact bar. Refer to *Front Bumper Fascia Replacement on page 3-57*.
8. Remove the drive motor coolant radiator assembly. Refer to *Drive Motor Battery Coolant Radiator Replacement on page 9-312*.
9. Place a clean shop cloth under the brake master cylinder to absorb any brake fluid when disconnecting the brake pipe fitting.



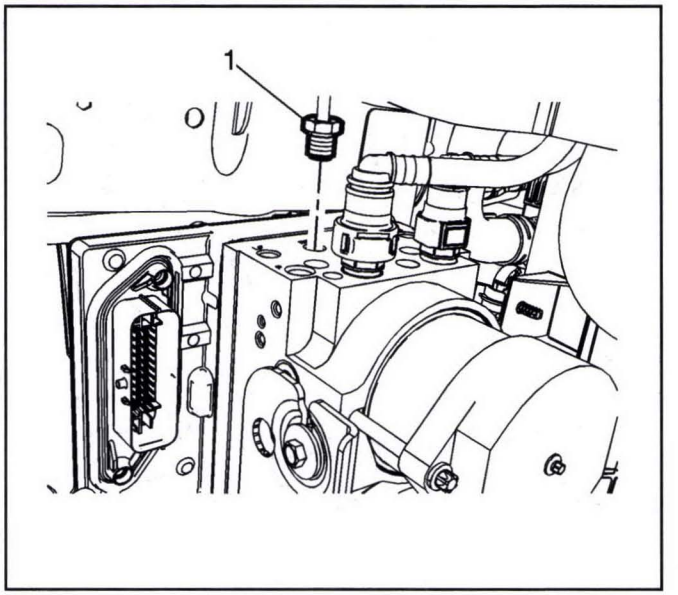
3222158

10. Disconnect the rear brake pressure modulator valve pipe fitting (1) from the master cylinder.
11. Plug the master cylinder port to prevent brake fluid loss and contamination.
12. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
13. Remove the front compartment front splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.



3222137

14. Release the rear brake pressure modulator valve pipe from the brake pipe retainer (1).

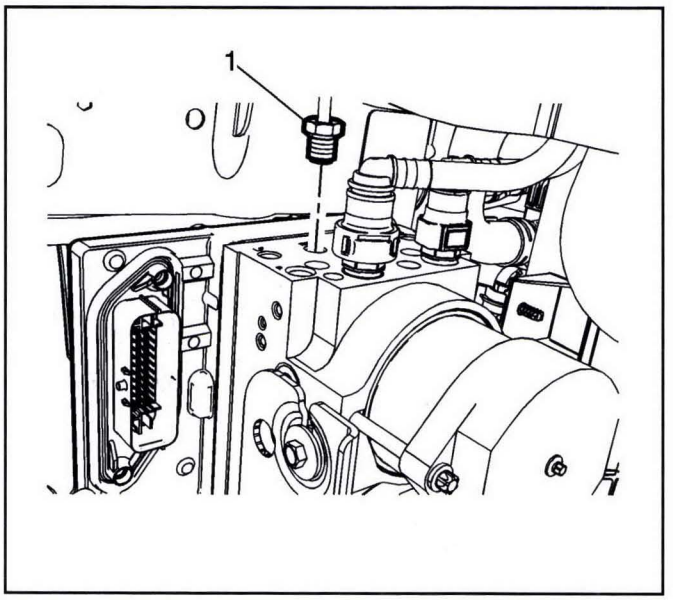


3222160

15. Disconnect the rear brake pressure modulator valve pipe fitting (1) from the electric hydraulic control unit (EHCU).
16. Plug the EHCU port to prevent brake fluid loss and contamination.
17. Remove the rear brake pressure modulator valve pipe.

Installation Procedure

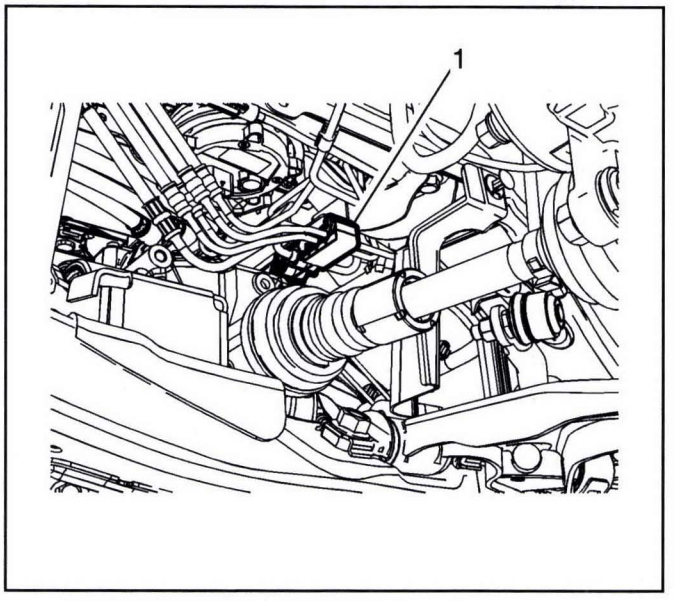
1. Install the rear brake pressure modulator valve pipe.



3222160

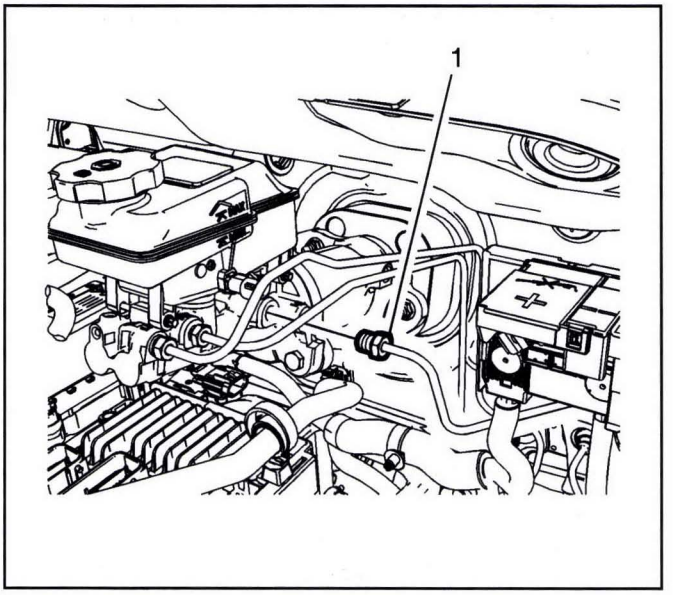
Caution: Refer to *Fastener Caution on page 0-8*.

2. Install the rear brake pressure modulator valve pipe fitting (1) to the EHCU and tighten the fitting to **18 N•m (13 lb ft)**.



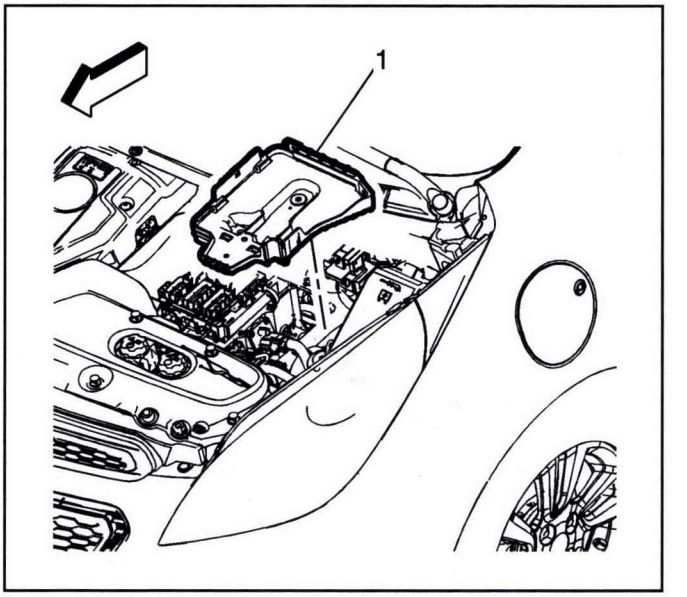
3222137

3. Secure the rear brake pressure modulator valve pipe to the brake pipe retainer (1).
4. Install the front compartment front splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.
5. Lower the vehicle.



3222158

6. Install the rear brake pressure modulator valve pipe fitting (1) to the master cylinder and tighten the fitting to **18 N•m (13 lb ft)**.
7. Install the drive motor coolant radiator assembly. Refer to *Drive Motor Battery Coolant Radiator Replacement on page 9-312*.
8. Install the front bumper impact bar. Refer to *Front Bumper Fascia Replacement on page 3-57*.
9. Install the heater coolant pump. Refer to *Heater Coolant Pump Replacement on page 10-56*.



3216630

10. Install the battery tray (1). Refer to *Battery Tray Replacement on page 9-30*.
11. Bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*.

Front Brake Pipe Replacement - Right Side

Removal Procedure

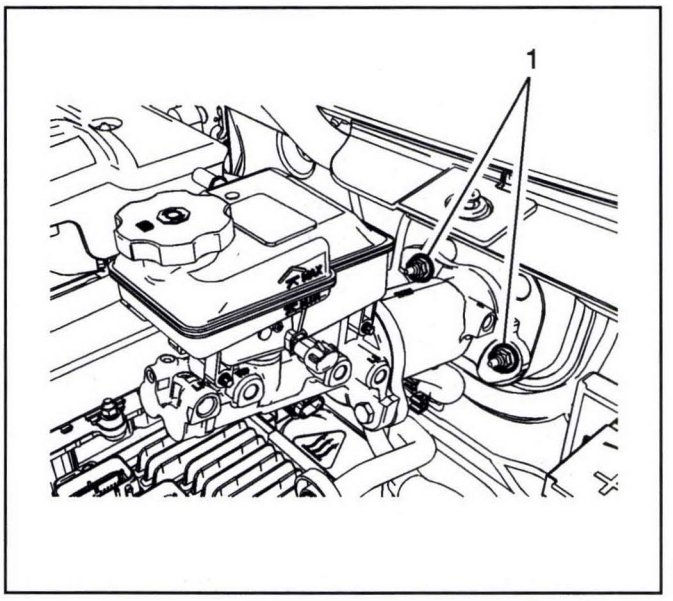
Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

Note: The transmission must be in the PARK position, the power button in the OFF position, and the brakes not applied to ensure the brake modulator and high pressure accumulator (HPA) pressure relief occurs. This process will take approximately 1 to 3 minutes.

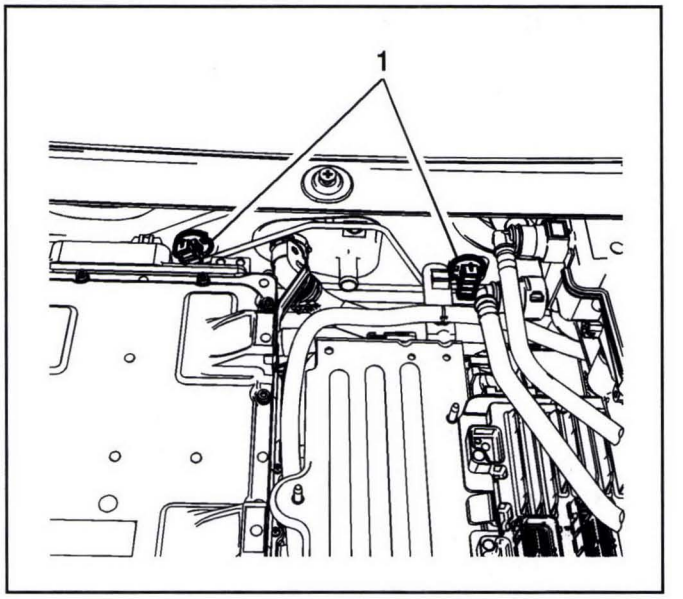
1. Place the transmission in PARK.
2. Place the power button in the OFF position.
3. Remove the remote keyless entry (RKE) transmitter and close all of the vehicle doors.

   Note: During the pressure relief process, the fluid level in the master cylinder reservoir will rise. Do not remove the master cylinder reservoir cap during the pressure relief process.
4. Wait approximately 3 minutes for the HPA pressure relief to occur.
5. Remove the battery. Refer to *Battery Replacement on page 9-28*.
6. Remove the high voltage disconnect circuit connector cover. Refer to *High Voltage Disconnect Circuit Connector Cover Replacement on page 9-174*.
7. Remove the plenum front panel. Refer to *Plenum Front Panel Replacement on page 3-38*.



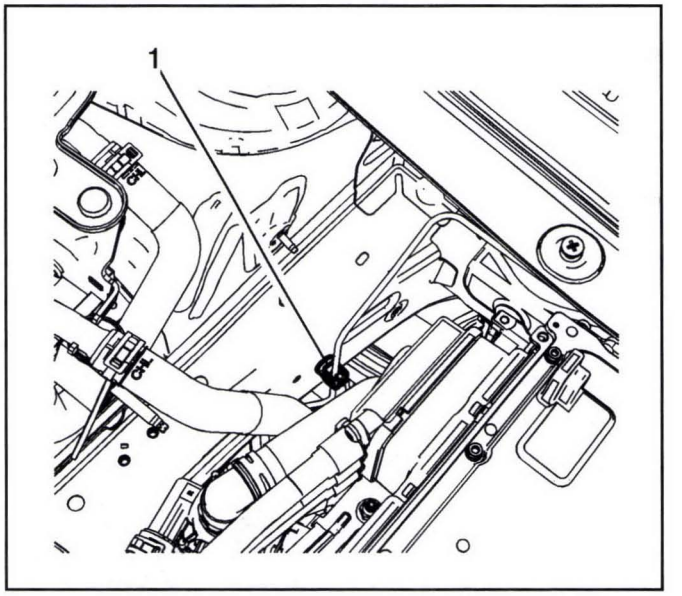
3217052

8. Remove the master cylinder nuts (1) and remove the master cylinder. Refer to *Master Cylinder Replacement on page 5-168*.



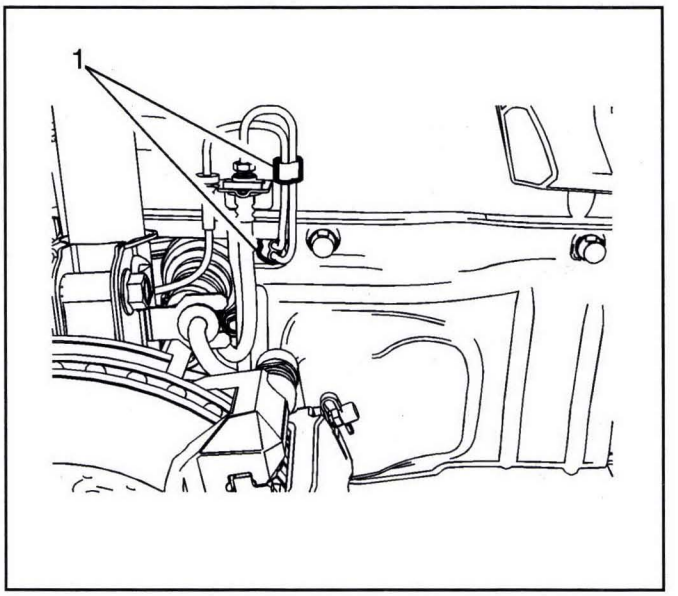
3222522

9. Release the right front brake pipe from the retainers (1) on the dash panel.



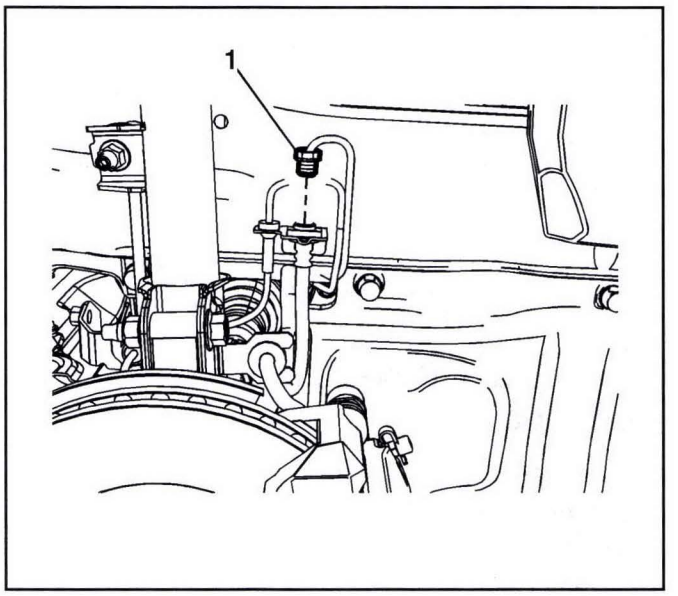
3222528

10. Release the right front brake pipe from the retainer (1) on the frame rail.
11. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
12. Remove the right side front compartment front splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.



3222534

13. Release the right front brake pipe from the wheel speed sensor harness clips (1).

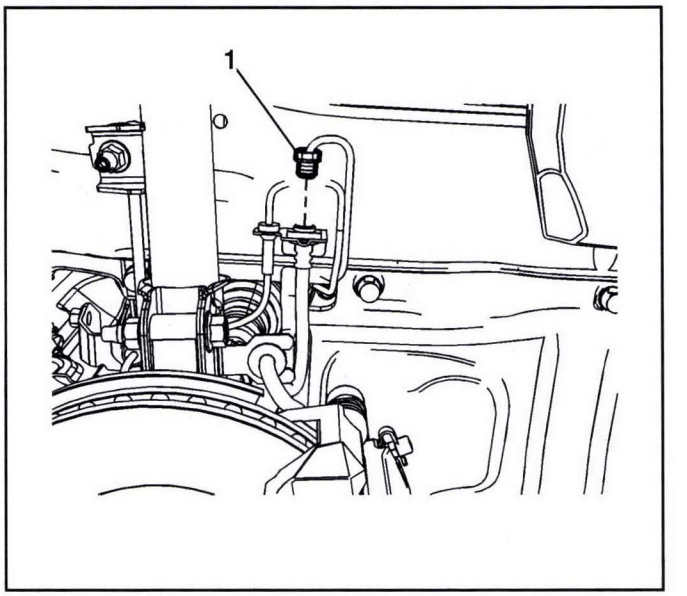


3222538

14. Disconnect the right front brake pipe fitting (1) from the brake hose.
15. Plug the brake hose fitting to prevent brake fluid loss and contamination.
16. Remove the right front brake pipe.

Installation Procedure

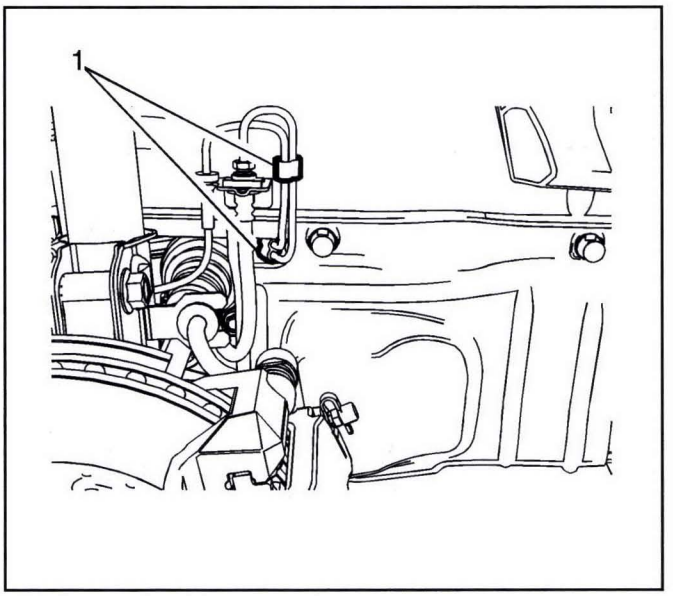
1. Install the right front brake pipe.



3222538

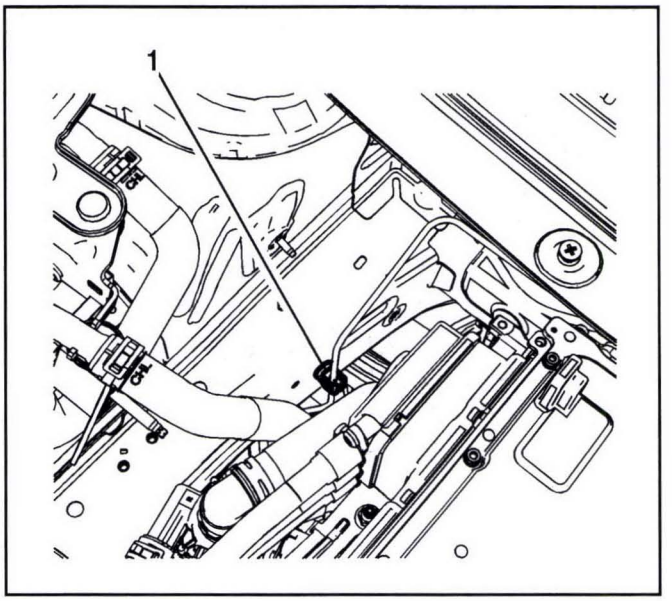
Caution: Refer to *Fastener Caution on page 0-8*.

2. Install the right front brake pipe fitting (1) to the brake hose and tighten the fitting to **18** N•m **(13 lb ft)**.



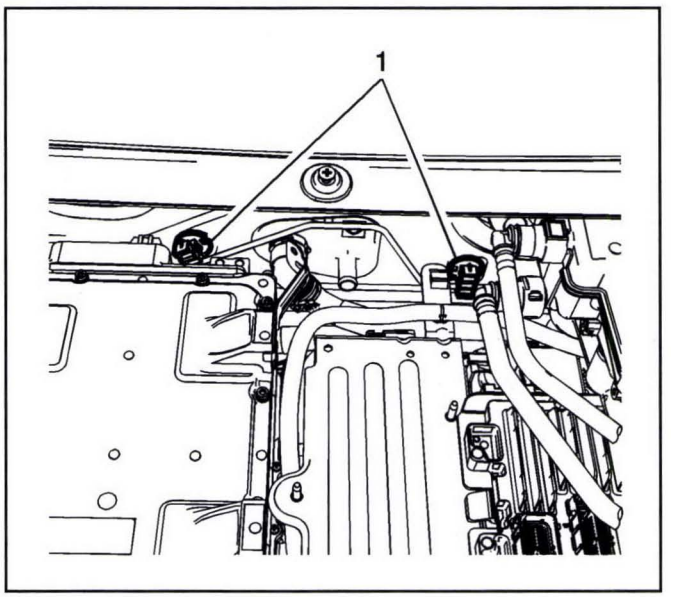
3222534

3. Install the right front brake pipe to the wheel speed sensor harness clips (1).
4. Install the right front compartment front splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.
5. Lower the vehicle.



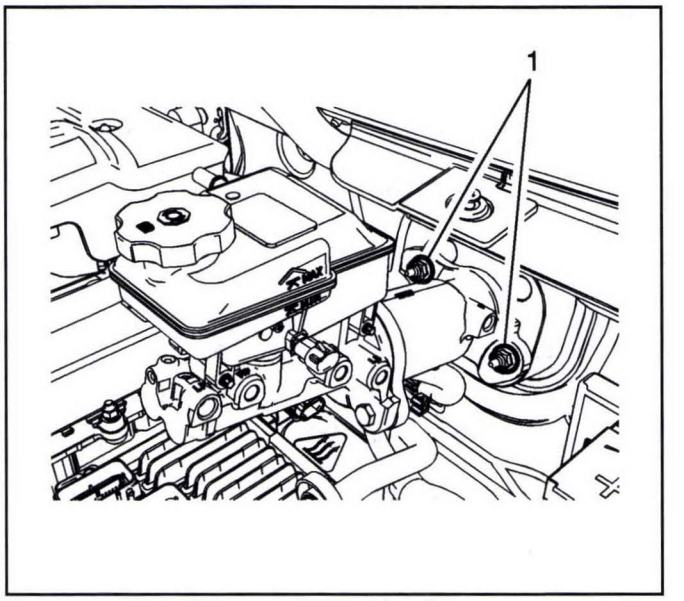
3222528

6. Install the right front brake pipe to the retainer (1) on the frame rail.



3222522

7. Install the right front brake pipe to the retainers (1) on the dash panel.



3217052

8. Install the master cylinder and the master cylinder nuts (1). Refer to *Master Cylinder Replacement on page 5-168*.
9. Install the plenum front panel. Refer to *Plenum Front Panel Replacement on page 3-38*.
10. Install the high voltage disconnect circuit connector cover. Refer to *High Voltage Disconnect Circuit Connector Cover Replacement on page 9-174*.
11. Install the battery. Refer to *Battery Replacement on page 9-28*.
12. Bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*.

Front Brake Pipe Replacement - Left Side

Removal Procedure

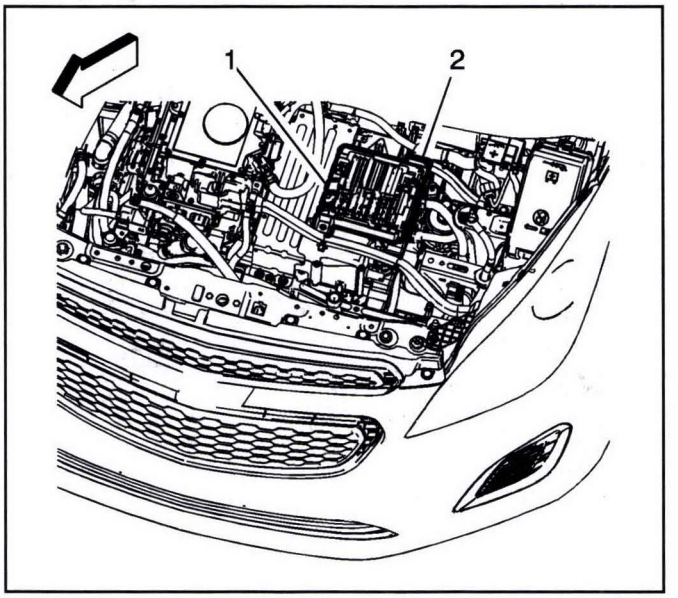
Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

Note: The transmission must be in the PARK position, the power button in the OFF position, and the brakes not applied to ensure the brake modulator and high pressure accumulator (HPA) pressure relief occurs. This process will take approximately 1 to 3 minutes.

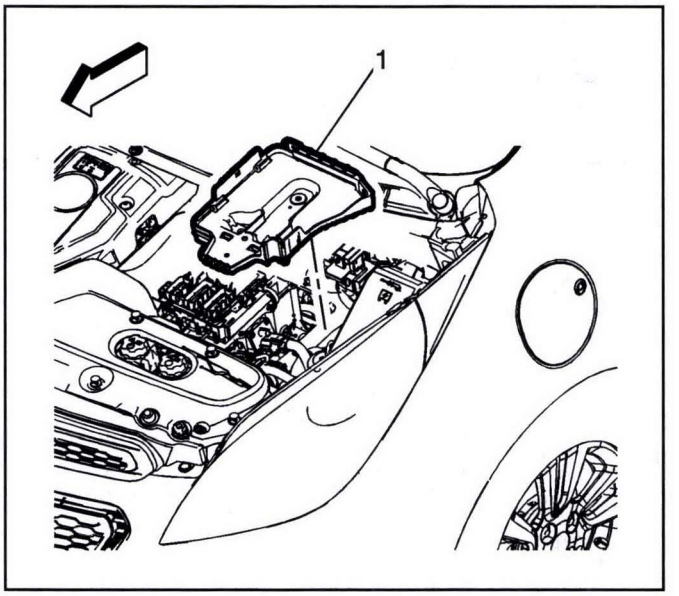
1. Place the transmission in PARK.
2. Place the power button in the OFF position.
3. Remove the remote keyless entry (RKE) transmitter and close all of the vehicle doors.

   Note: During the pressure relief process, the fluid level in the master cylinder reservoir will rise. Do not remove the master cylinder reservoir cap during the pressure relief process.
4. Wait approximately 3 minutes for the HPA pressure relief to occur.



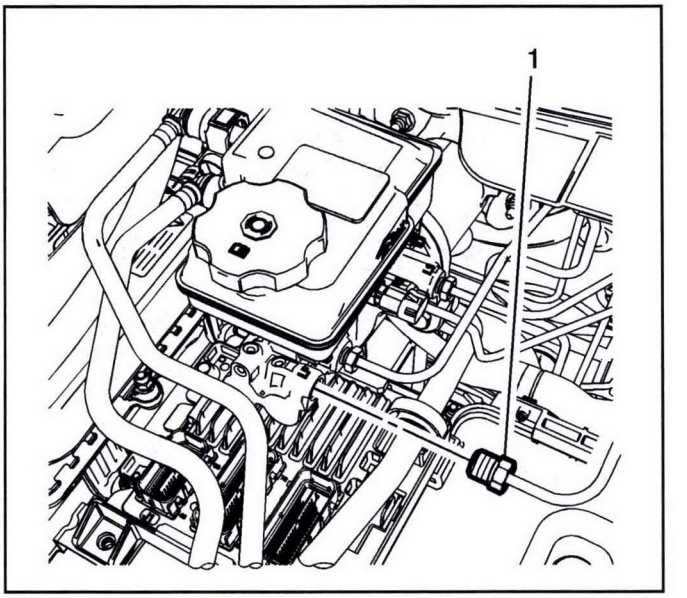
3240558

5. Remove the engine control module (ECM) (2). Refer to *Engine Control Module Replacement on page 9-171*.



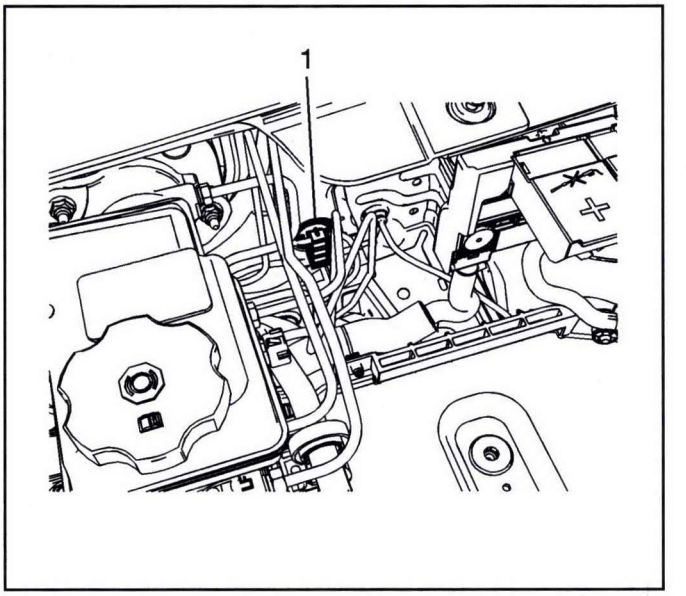
3216630

6. Remove the battery tray (1). Refer to *Battery Tray Replacement on page 9-30*.
7. Remove the heater coolant pump. Refer to *Heater Coolant Pump Replacement on page 10-56*.



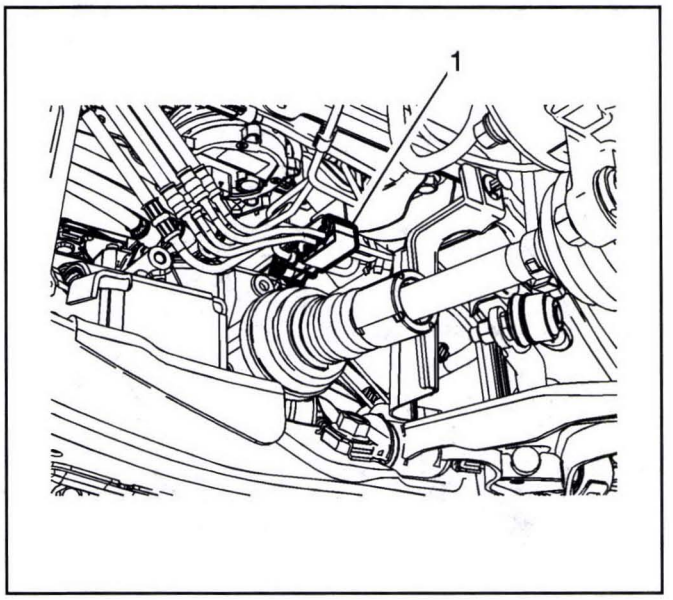
3223065

8. Disconnect the left front brake pipe fitting (1) from the master cylinder.
9. Plug the master cylinder port to prevent brake fluid loss and contamination.



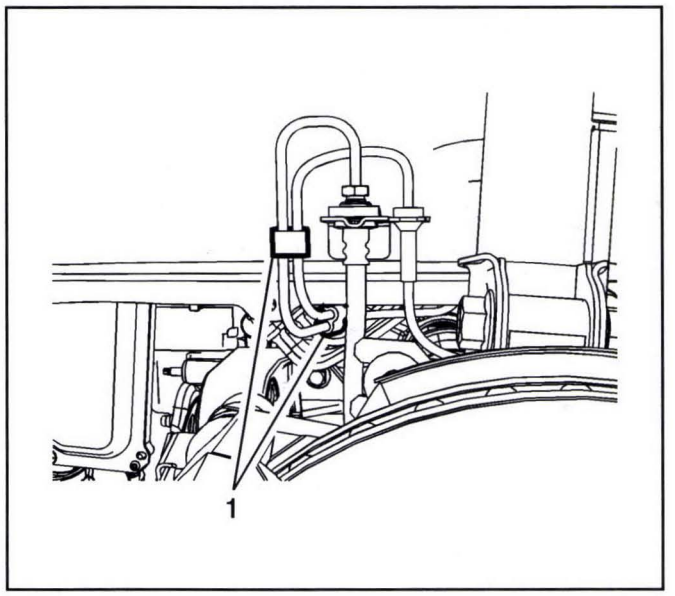
3223070

10. Release the left front brake pipe from the retainer (1) on the dash panel.
11. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
12. Remove the left side front compartment front splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.



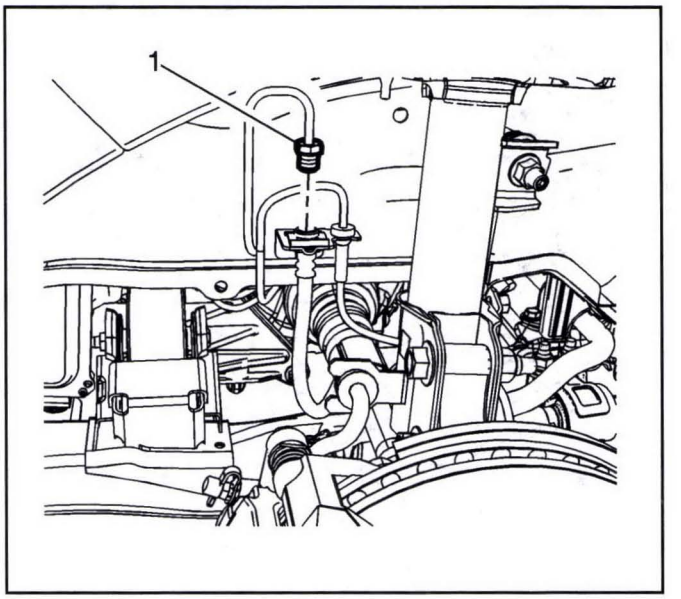
3222137

13. Release the left front brake pipe from the brake pipes retainer (1).



3223073

14. Release the left front brake pipe from the wheel speed sensor harness clips (1).

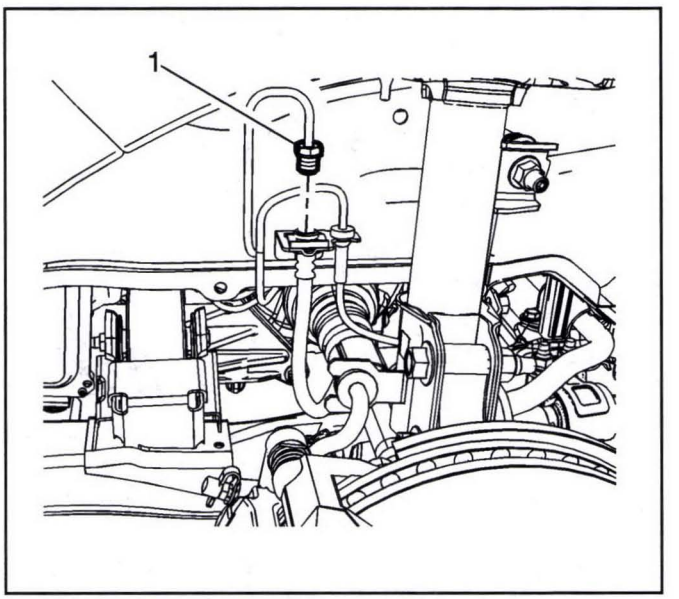


3223074

15. Disconnect the left front brake pipe fitting (1) from the brake hose.
16. Plug the brake hose fitting to prevent brake fluid loss and contamination.
17. Remove the left front brake pipe.

Installation Procedure

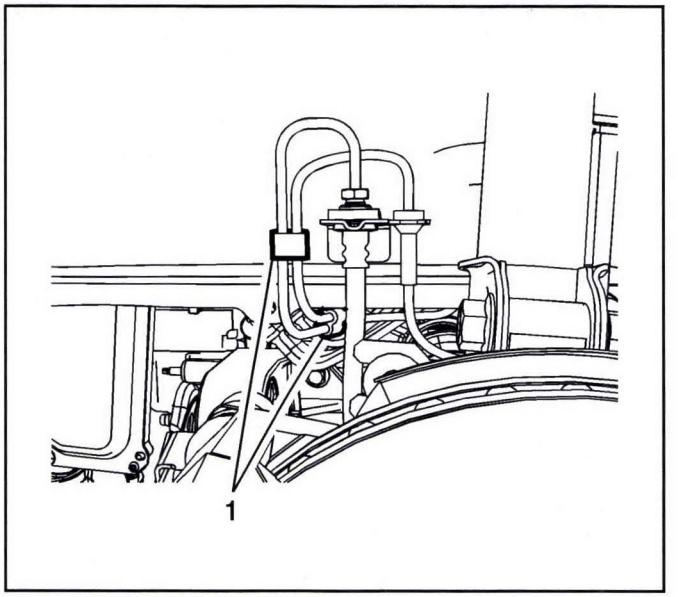
1. Install the left front brake pipe.



3223074

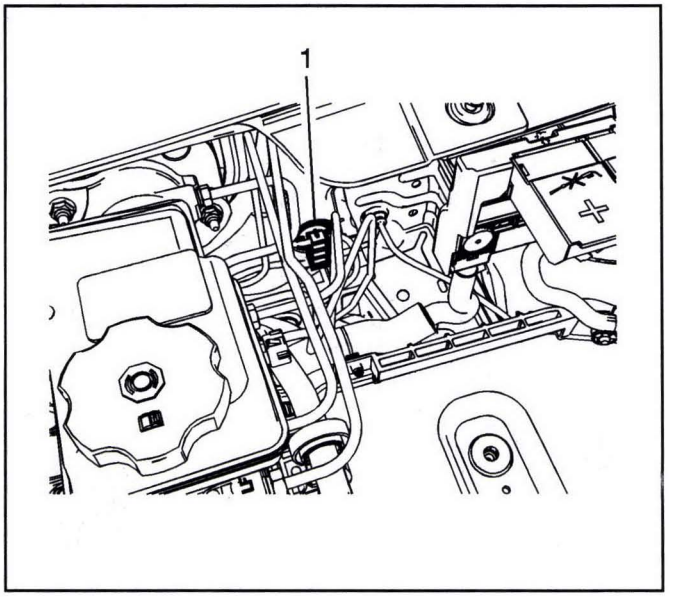
Caution: Refer to *Fastener Caution on page 0-8*.

2. Install the left front brake pipe fitting (1) to the brake hose and tighten the fitting to **18 N•m (13 lb ft)**.



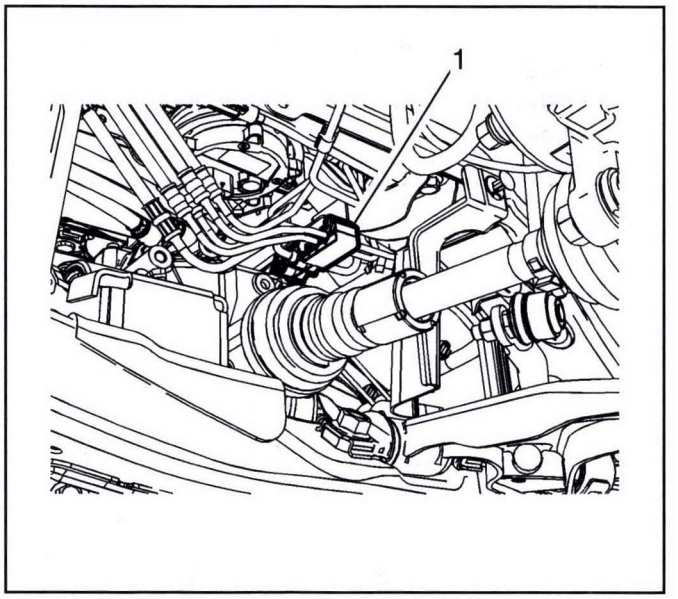
3223073

3. Install the left front brake pipe to the wheel speed sensor harness clips (1).



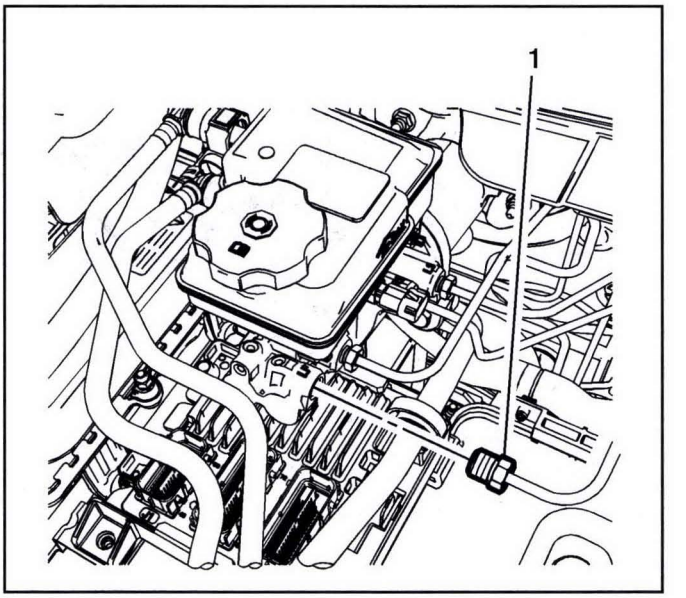
3223070

7. Install the left front brake pipe to the retainer (1) on the dash panel.



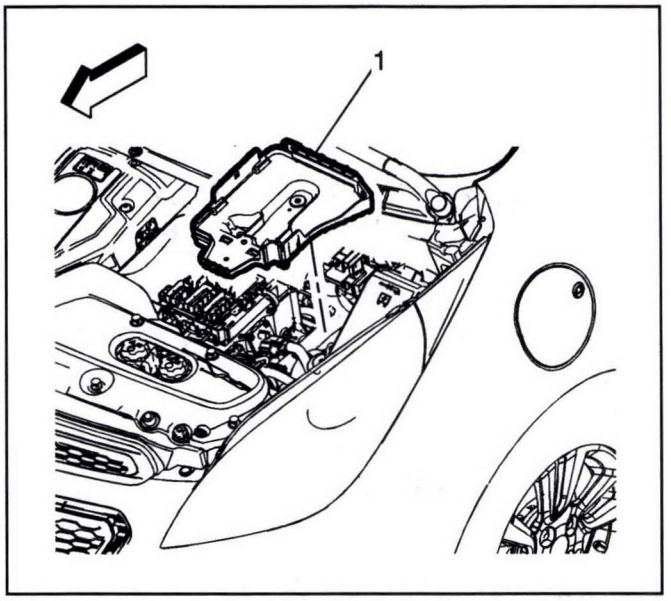
3222137

4. Install the left front brake pipe to the brake pipes retainer (1).
5. Install the left front compartment front splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.
6. Lower the vehicle.



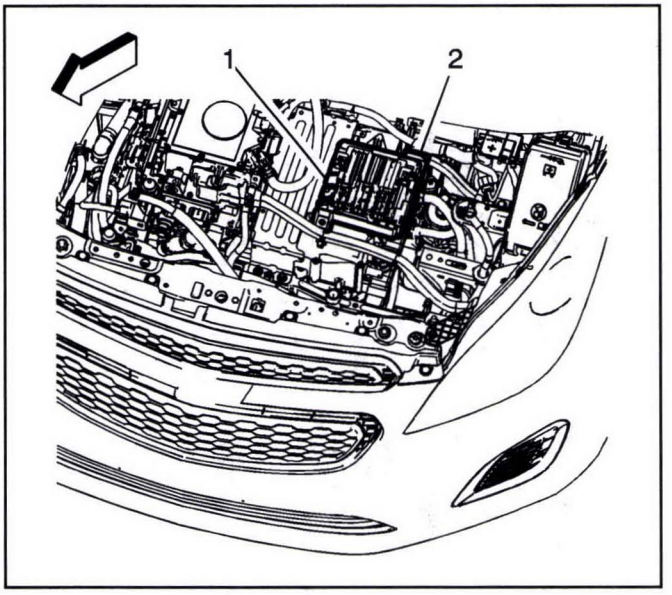
3223065

8. Install the right front brake pipe fitting (1) to the master cylinder and tighten the fitting to **18** N•m **(13 lb ft)**.
9. Install the heater coolant pump. Refer to *Heater Coolant Pump Replacement on page 10-56*.



3216630

10. Install the battery tray (1). Refer to *Battery Tray Replacement on page 9-30*.



3240558

11. Install the ECM (2). Refer to *Engine Control Module Replacement on page 9-171*.
12. Bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*.

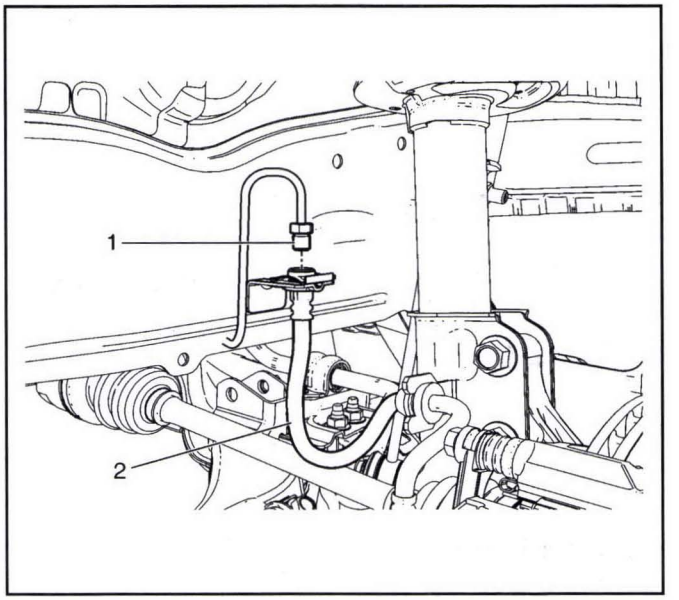
Front Brake Hose Replacement

Removal Procedure

Warning: Refer to Brake Dust Warning on page 0-4.

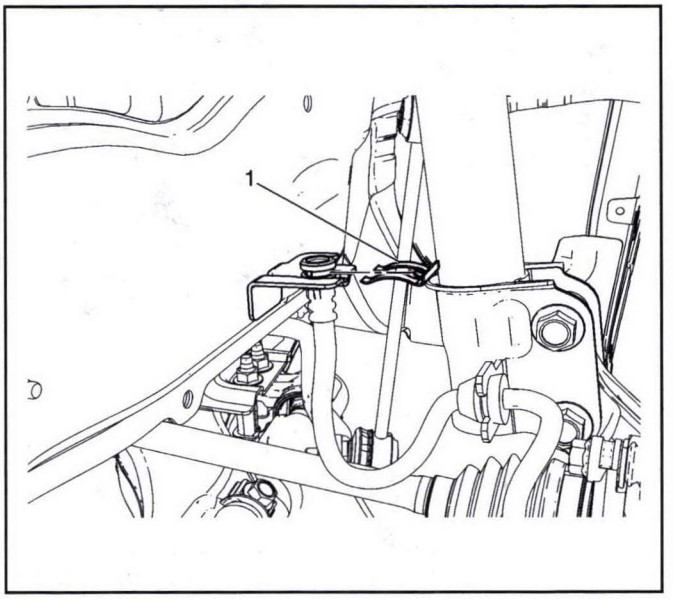
Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.



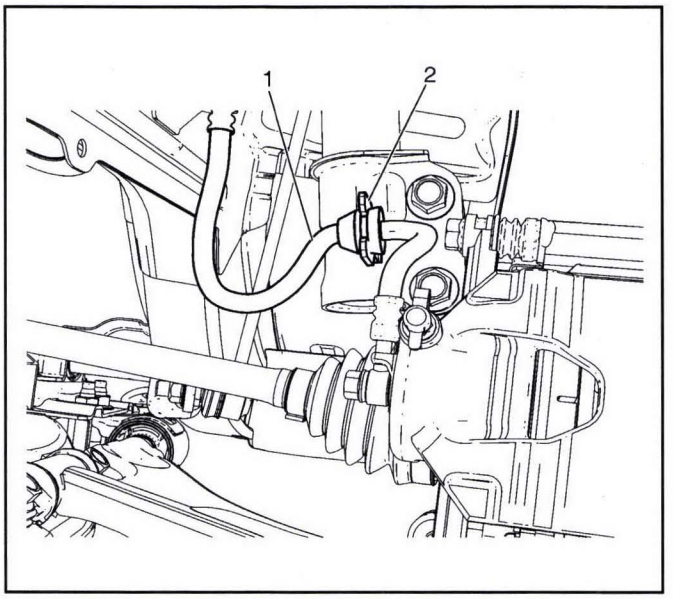
2327927

3. Remove the brake pipe fitting (1) from the brake hose (2).
4. Cap the brake pipe fitting to prevent brake fluid loss and contamination.



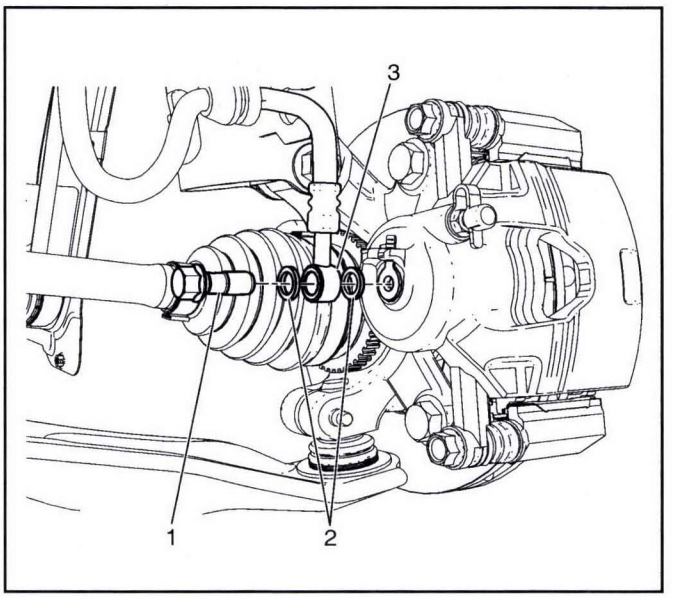
2327926

5. Remove the brake hose retainer (1).



2327922

6. Release the brake hose grommet (1) from the strut bracket (2).

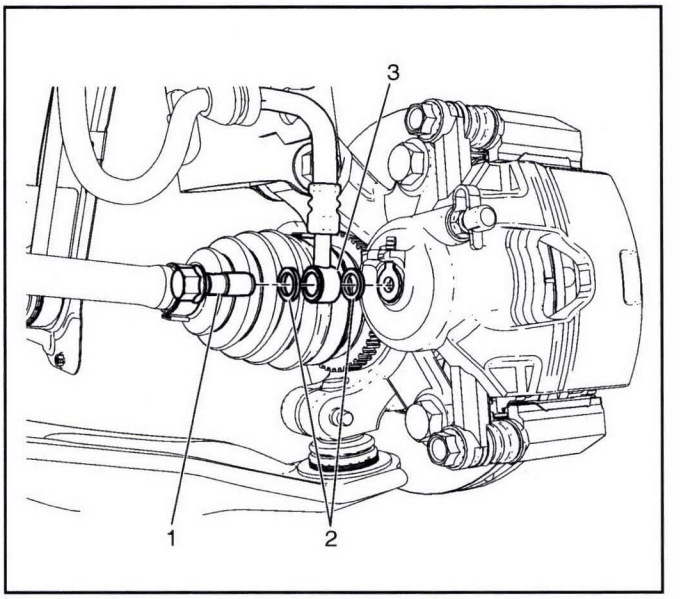


2327921

7. Remove the brake hose fitting bolt (1).
   Note: Do not reuse the brake hose fitting gaskets.
8. Remove and discard the brake hose fitting gaskets (2) from the brake hose fitting (3).
9. Remove the brake hose from the vehicle.

Installation Procedure

1. Install the brake hose to the vehicle.

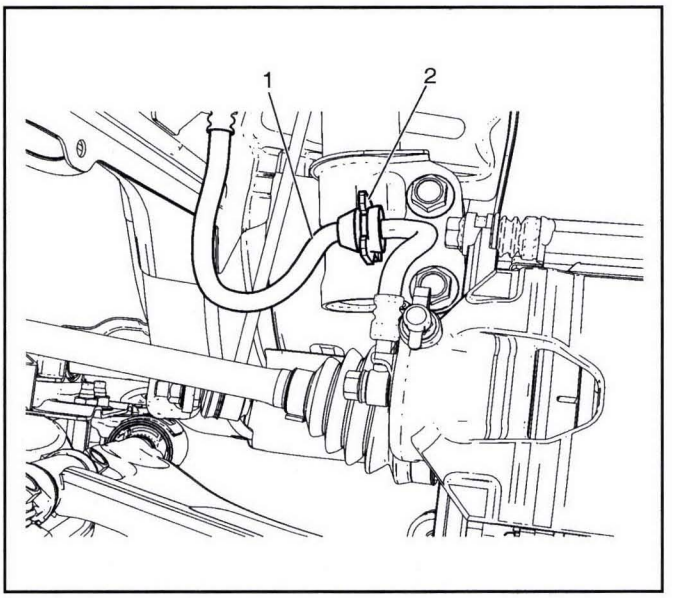


2327921

2. Assemble the brake hose fitting bolt (1) and the new brake hose fitting gaskets (2) to the brake hose (3).

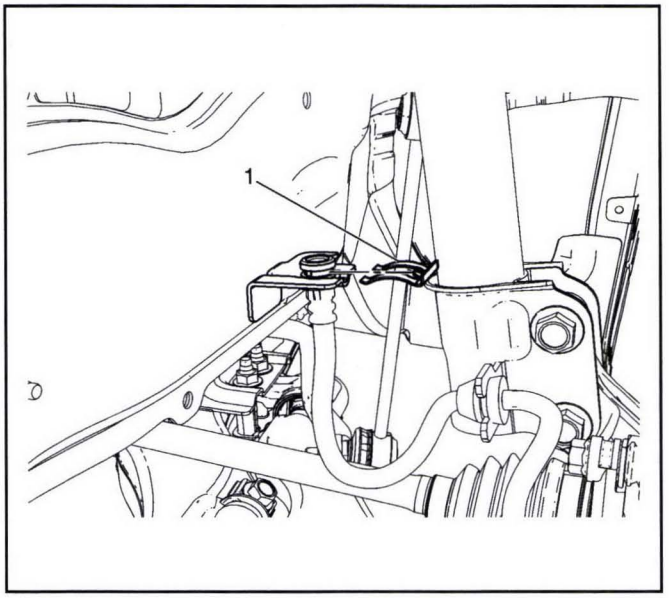
Caution: Refer to *Fastener Caution on page 0-8*.

3. Install the brake hose assembly to the caliper and tighten the brake hose fitting bolt to **40** N•m **(30 lb ft)**.



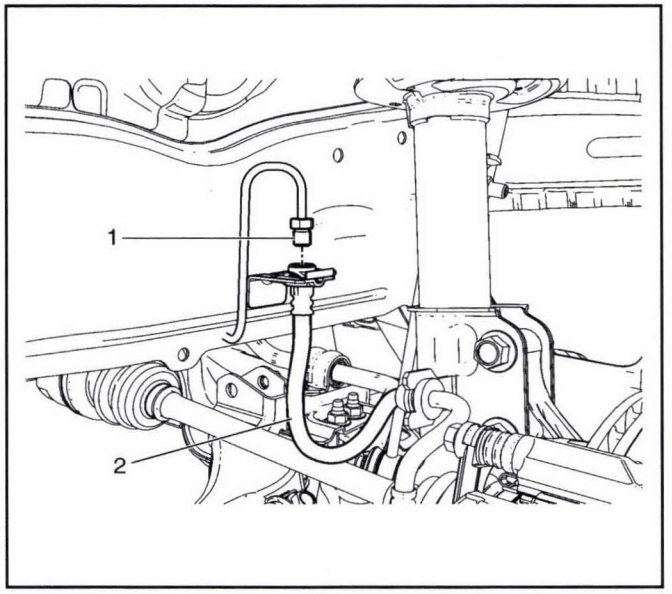
2327922

4. Install the brake hose grommet (1) to the strut bracket (2).



2327926

5. Install the brake hose retainer (1).



2327927

6. Install the brake pipe fitting (1) to the brake hose (2) and tighten the brake pipe fitting to **18** N•m **(13 lb ft)**.
7. Bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*.
8. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.

Rear Brake Intermediate Number 1 Pipe Replacement

Removal Procedure

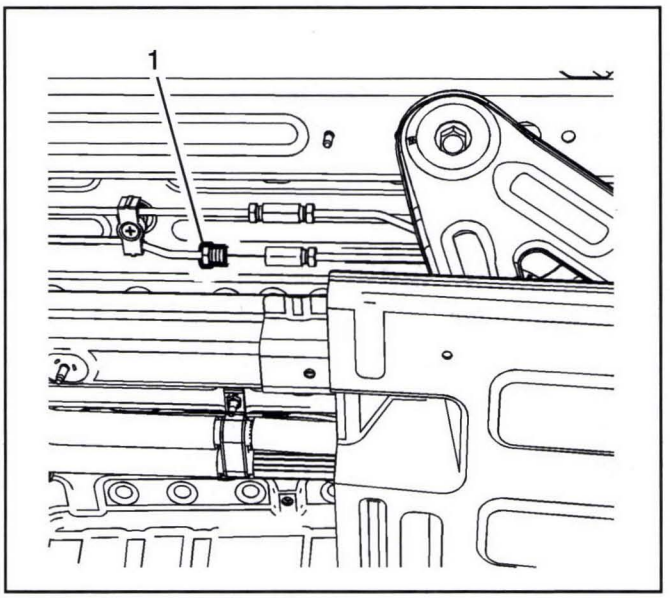
Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

Note: The transmission must be in the PARK position, the power button in the OFF position, and the brakes not applied to ensure the brake modulator and high pressure accumulator (HPA) pressure relief occurs. This process will take approximately 1 to 3 minutes.

1. Place the transmission in PARK.
2. Place the power button in the OFF position.
3. Remove the remote keyless entry (RKE) transmitter and close all of the vehicle doors.

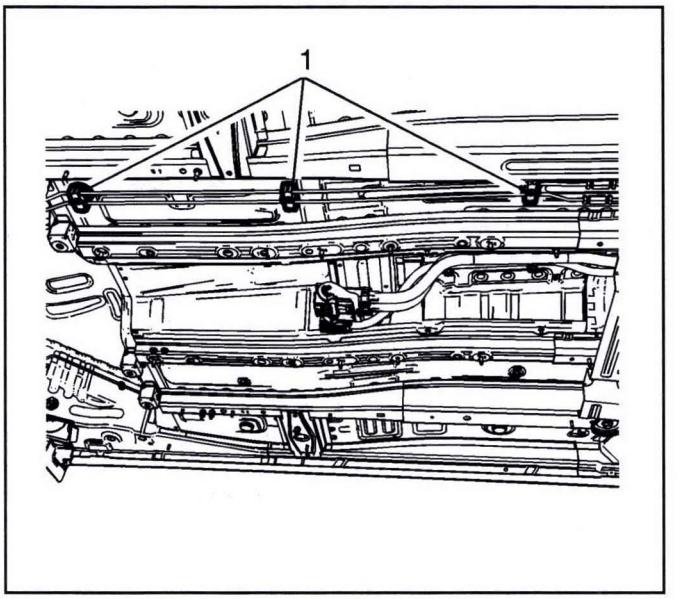
   Note: During the pressure relief process, the fluid level in the master cylinder reservoir will rise. Do not remove the master cylinder reservoir cap during the pressure relief process.
4. Wait approximately 3 minutes for the HPA pressure relief to occur.
5. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
6. Remove the right side underbody front air deflector. Refer to *Underbody Front Air Deflector Replacement - Right Side on page 3-128*.
7. Lower and support the drive motor battery assembly enough to access the brake pipe retainers. Refer to *Drive Motor Battery Replacement and Shipping Preparation on page 9-524*.



3225411

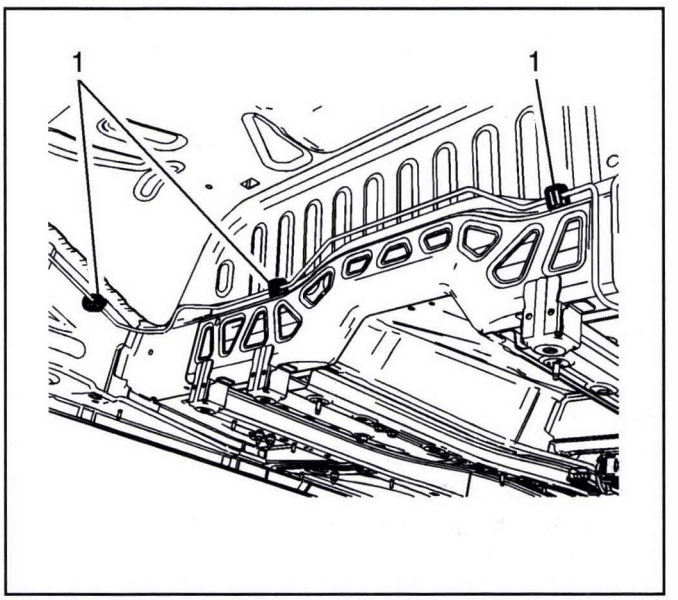
8. Disconnect the rear brake intermediate number 1 brake pipe fitting (1) from the left rear brake front union.

9. Cap the left rear brake front union to prevent brake fluid loss and contamination.



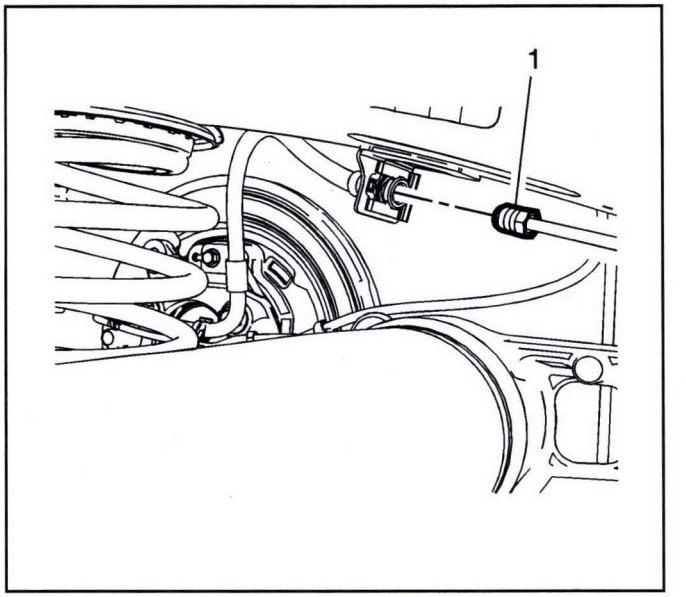
3225414

10. Release the rear brake intermediate number 1 brake pipe from the retainers (1) on the floor panel.



3225416

11. Release the rear brake intermediate number 1 brake pipe from the retainers (1) on the floor panel.

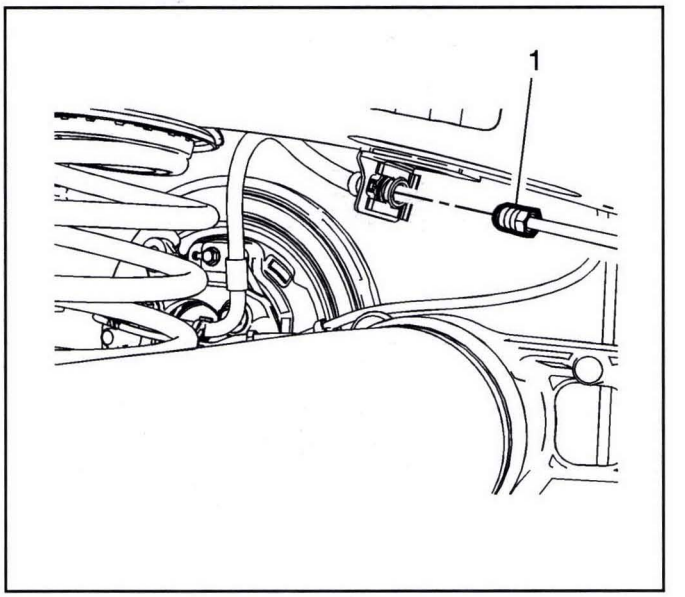


3225420

12. Disconnect the rear brake intermediate number 1 brake pipe fitting (1) from the brake hose.
13. Plug the brake hose fitting to prevent brake fluid loss and contamination.
14. Remove the rear brake intermediate number 1 brake pipe.

Installation Procedure

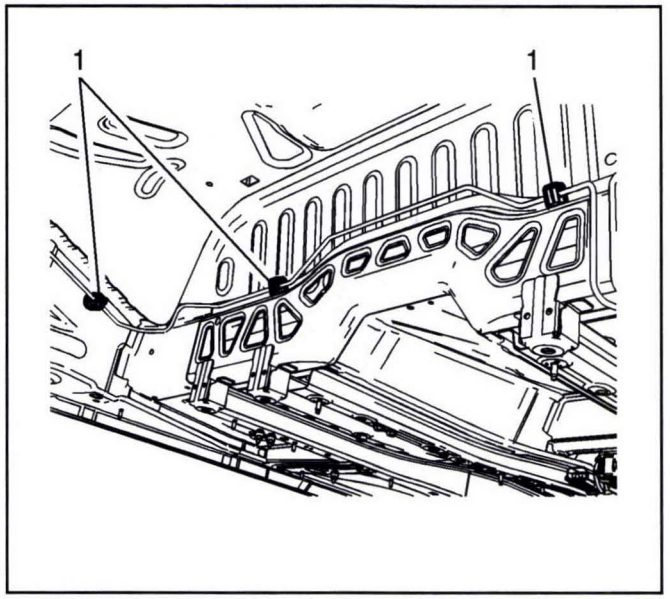
1. Install the rear brake intermediate number 1 brake pipe.



3225420

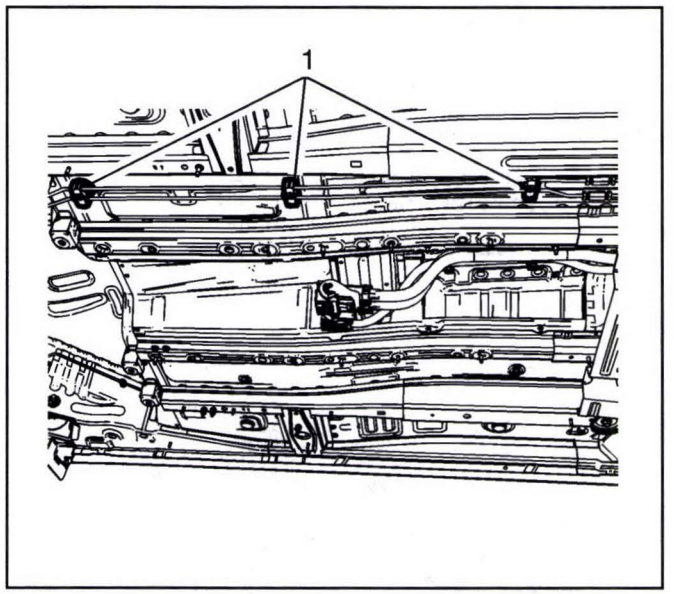
Caution: Refer to *Fastener Caution on page 0-8*.

2. Install the rear brake intermediate number 1 brake pipe fitting (1) to the brake hose and tighten the fitting to **18 N•m (13 lb ft)**.



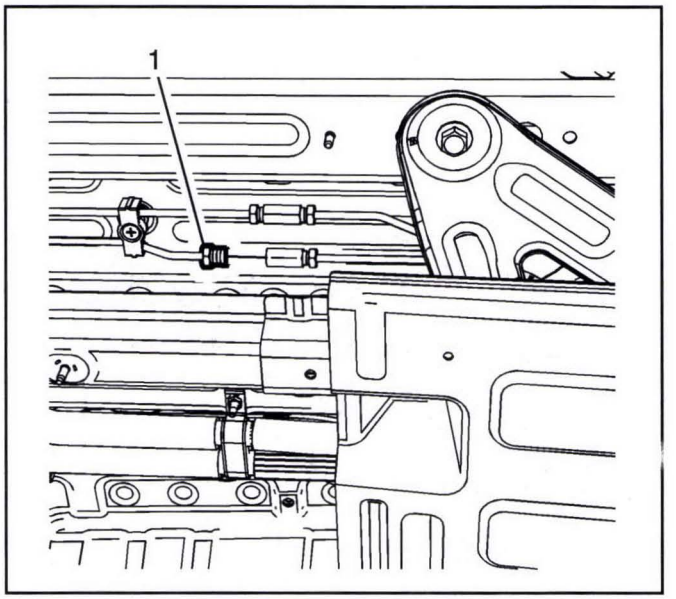
3225416

3. Install the rear brake intermediate number 1 brake pipe to the retainers (1) on the floor panel.



3225414

4. Install the rear brake intermediate number 1 brake pipe from the retainers (1) on the floor panel.



3225411

5. Insall the rear brake intermediate number 1 brake pipe fitting (1) to the left rear brake front union and tighten the fitting to **18 N•m (13 lb ft)**.
6. Reposition and install the drive motor battery assembly. Refer to *Drive Motor Battery Replacement and Shipping Preparation on page 9-524*.
7. Install the right side underbody front air deflector. Refer to *Underbody Front Air Deflector Replacement - Right Side on page 3-128*.
8. Bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*.

Rear Brake Intermediate Number 2 Pipe Replacement

Removal Procedure

Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

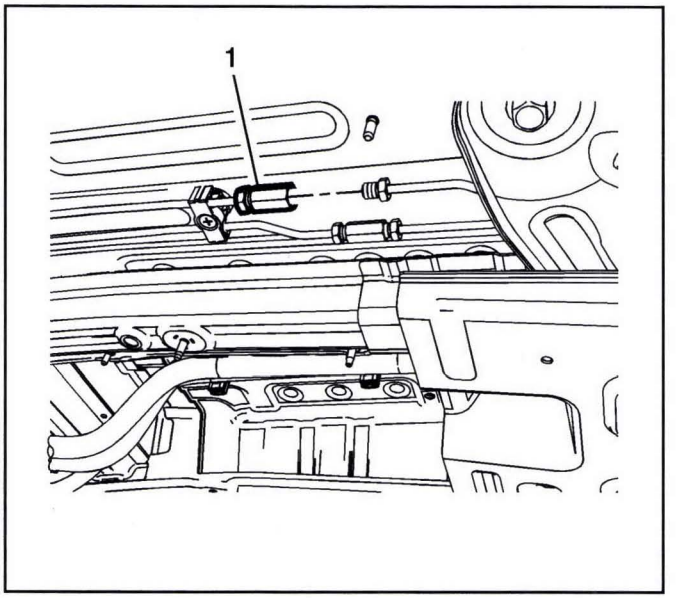
Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

Note: The transmission must be in the PARK position, the power button in the OFF position, and the brakes not applied to ensure the brake modulator and high pressure accumulator (HPA) pressure relief occurs. This process will take approximately 1 to 3 minutes.

1. Place the transmission in PARK.
2. Place the power button in the OFF position.
3. Remove the remote keyless entry (RKE) transmitter and close all of the vehicle doors.

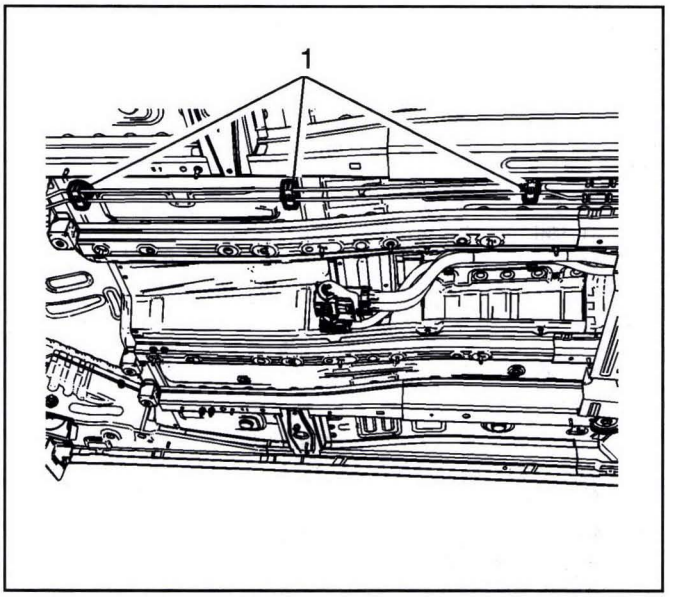
   Note: During the pressure relief process, the fluid level in the master cylinder reservoir will rise. Do not remove the master cylinder reservoir cap during the pressure relief process.
4. Wait approximately 3 minutes for the HPA pressure relief to occur.

5. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
6. Remove the right side underbody front air deflector. Refer to *Underbody Front Air Deflector Replacement - Right Side on page 3-128*.
7. Lower and support the drive motor battery assembly enough to access the brake pipe retainers. Refer to *Drive Motor Battery Replacement and Shipping Preparation on page 9-524*.



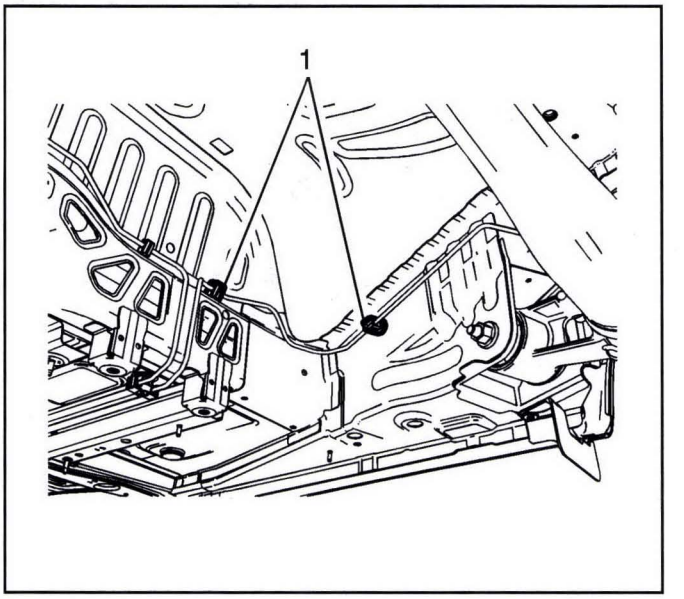
3225645

8. Disconnect the rear brake intermediate number 2 brake pipe union (1) from the right rear brake front pipe fitting.
9. Cap the right rear brake front pipe fitting to prevent brake fluid loss and contamination.



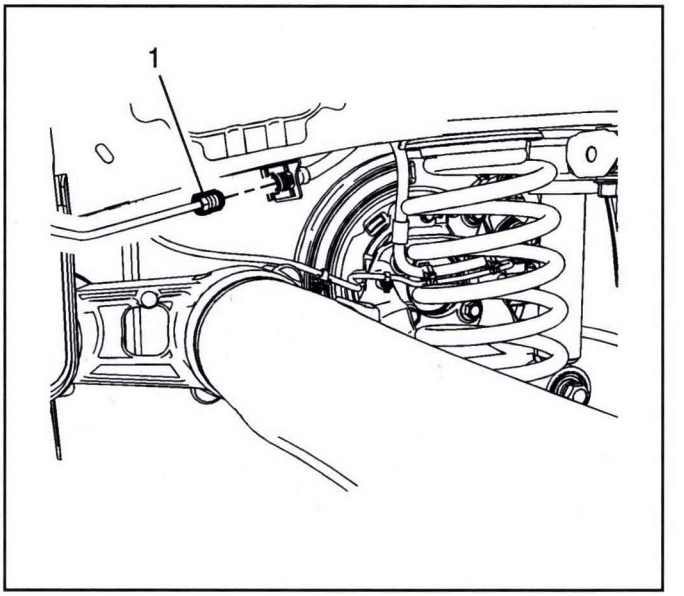
3225414

10. Release the rear brake intermediate number 2 brake pipe from the retainers (1) on the floor panel.



3225644

11. Release the rear brake intermediate number 2 brake pipe from the retainers (1) on the floor panel.

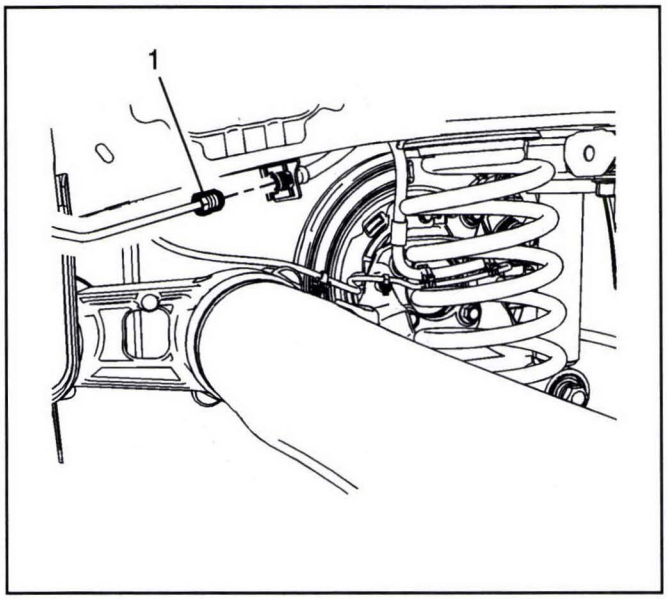


3225646

12. Disconnect the rear brake intermediate number 2 brake pipe fitting (1) from the brake hose.
13. Plug the brake hose fitting to prevent brake fluid loss and contamination.
14. Remove the rear brake intermediate number 2 brake pipe.

Installation Procedure

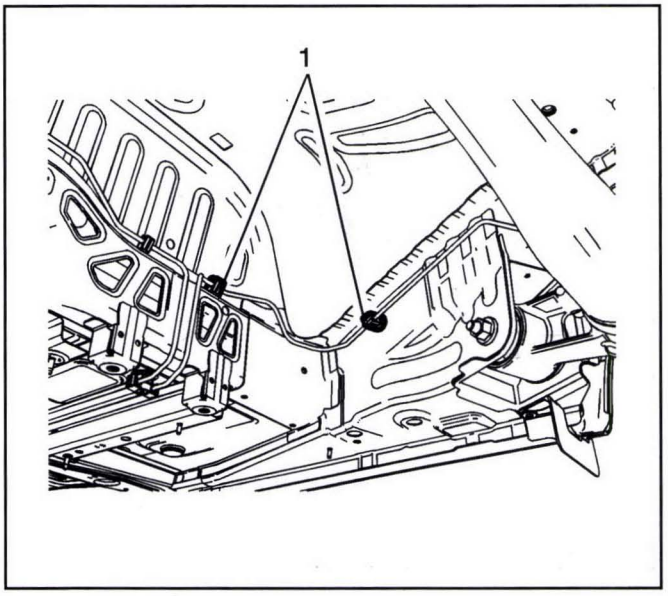
1. Install the rear brake intermediate number 2 brake pipe.



3225646

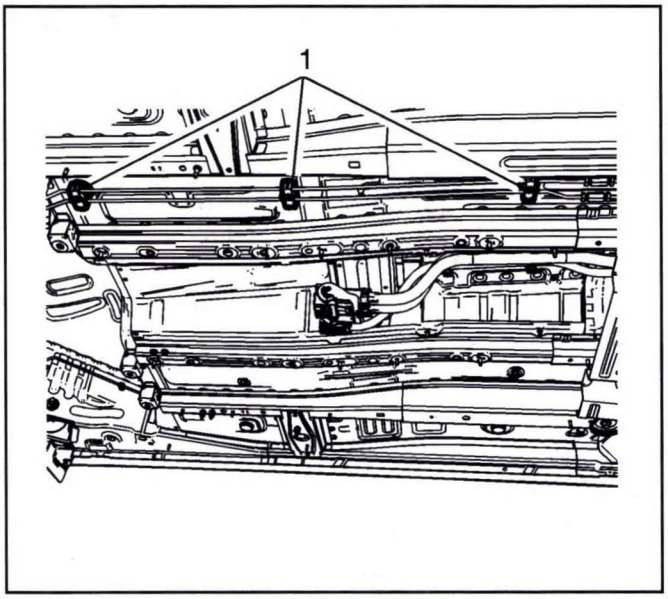
Caution: Refer to *Fastener Caution on page 0-8*.

2. Install the rear brake intermediate number 2 brake pipe fitting (1) to the brake hose and tighten the fitting to **18 N•m (13 lb ft)**.



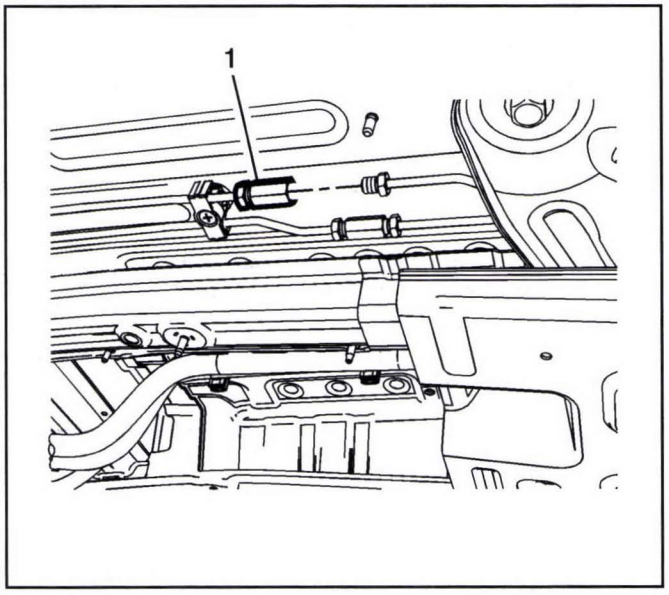
3225644

3. Install the rear brake intermediate number 2 brake pipe to the retainers (1) on the floor panel.



3225414

4. Install the rear brake intermediate number 2 brake pipe from the retainers (1) on the floor panel.



3225645

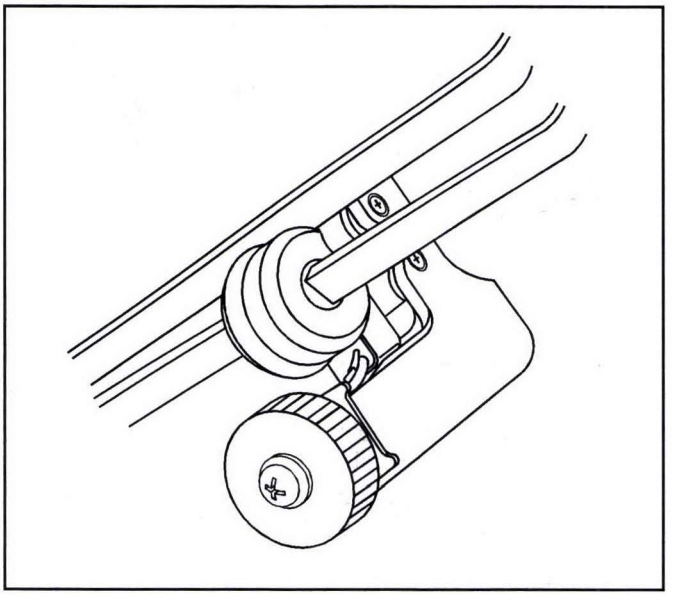
5. Install the rear brake intermediate number 2 brake pipe union (1) to the right rear brake front pipe fitting and tighten the fitting to **18 N•m (13 lb ft)**.
6. Reposition and install the drive motor battery assembly. Refer to *Drive Motor Battery Replacement and Shipping Preparation on page 9-524*.
7. Install the right side underbody front air deflector. Refer to *Underbody Front Air Deflector Replacement - Right Side on page 3-128*.
8. Bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*.

Rear Brake Pipe Replacement

Special Tools

CH-45405 Brake Pipe Flaring Kit

For equivalent regional tools, refer to *Special Tools on page 5-219*.



900937

Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Warning: Always use double walled steel brake pipe when replacing brake pipes. The use of any other pipe is not recommended and may cause brake system failure. Carefully route and retain replacement brake pipes. Always use the correct fasteners and the original location for replacement brake pipes. Failure to properly route and retain brake pipes may cause damage to the brake pipes and cause brake system failure.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

Note: When servicing the brake pipes, note the following:

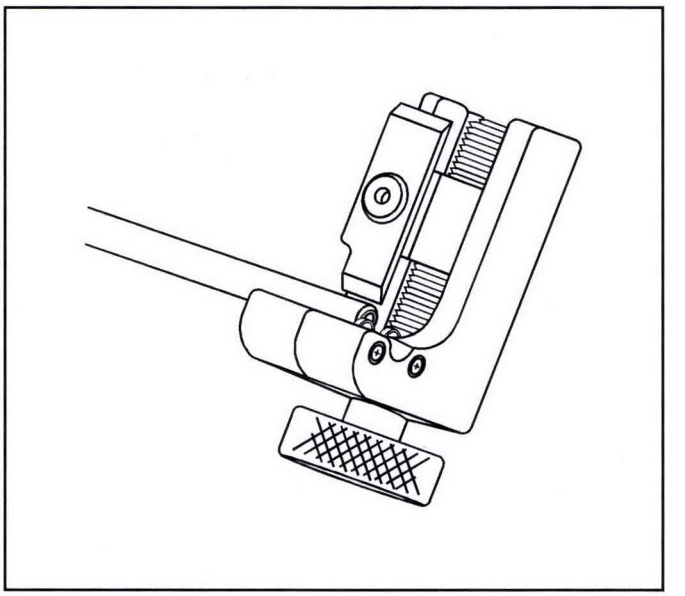
- If sectioning the brake pipe, use replacement pipe of the same type and outside diameter.
- Use fittings of the appropriate size and type.
- Only create flares of the same type or design as originally equipped on the vehicle.

1. Inspect the area of brake pipe to be repaired or replaced.
2. Release the brake pipe to be replaced from the retainers, as required.
3. Select an appropriate location to section the brake pipe, if necessary.
   - Allow adequate clearance in order to maneuver the *CH-45405* Brake Pipe Flaring Kit.
   - Avoid sectioning the brake pipe at bends or mounting points.
4. Using a string or wire, measure the length of the pipe to be replaced including all pipe bends.
5. Add to the measurement taken the appropriate additional length required for each flare to be created.

   Specification

   - 6.35 mm (0.250 in) for 4.76 mm (3/16 in) diameter pipe
   - 9.50 mm (0.374 in) for 6.35 mm (1/4 in) diameter pipe
   - 12.67 mm (0.499 in) for 7.94 mm (5/16 in) diameter pipe

   Note: Ensure that the brake pipe end to be flared is cut at a square, 90 degree angle to the pipe length.
6. Using the pipe cutter included in the *CH-45405* Brake Pipe Flaring Kit, carefully cut the brake pipe squarely to the measured length.
7. Remove the sectioned brake pipe from the vehicle.
8. Select the appropriate size of brake pipe and tube nuts, as necessary. The brake pipe outside diameter determines brake pipe size.



900939

9. Strip the nylon coating from the brake pipe end to be flared, if necessary.
   - Select the appropriate blade on the coating stripping tool included in the *CH-45405* Brake Pipe Flaring Kit, by unthreading the blade block from the stripping tool and installing the block with the desired blade facing the tool rollers.

     Specification

     – 6.35 mm (0.250 in) blade for 4.76 mm (3/16 in) diameter pipe

     – 9.50 mm (0.374 in) blade for 6.35 mm (1/4 in) and 7.94 mm (5/16 in) diameter pipe
   - Insert the brake pipe end to be flared into the stripping tool to the depth of the ledge on the tool rollers.

- While holding the brake pipe firmly against the stripping tool roller ledges, rotate the thumbwheel of the tool until the blade contacts the brake pipe coated surface.

  Note: Do not gouge the metal surface of the brake pipe.

- Rotate the stripping tool in a clockwise direction, ensuring that the brake pipe end remains against the tool roller ledges.
- After each successive revolution of the stripping tool, carefully rotate the thumbwheel of the tool clockwise, in order to continue stripping the coating from the brake pipe until the metal pipe surface is exposed.
- Loosen the thumbwheel of the tool and remove the brake pipe.

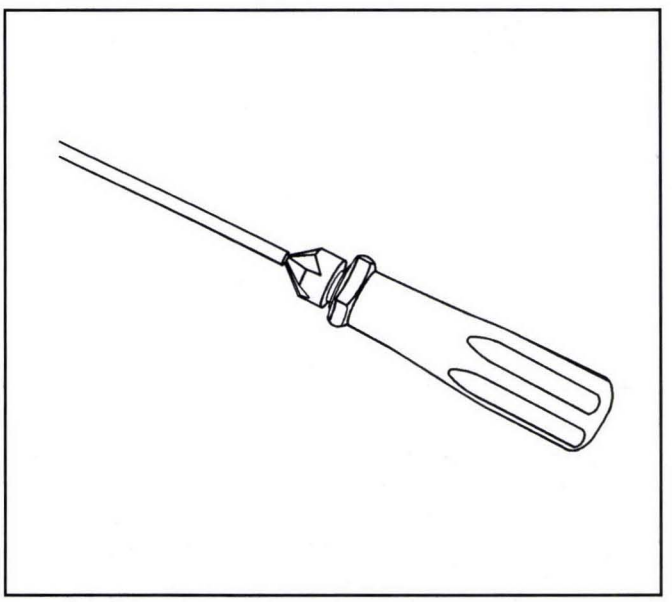
  Note: Ensure that all loose remnants of the nylon coating have been removed from the brake pipe.

- Inspect the stripped end of the brake pipe to ensure that the proper amount of coating has been removed.

  Specification

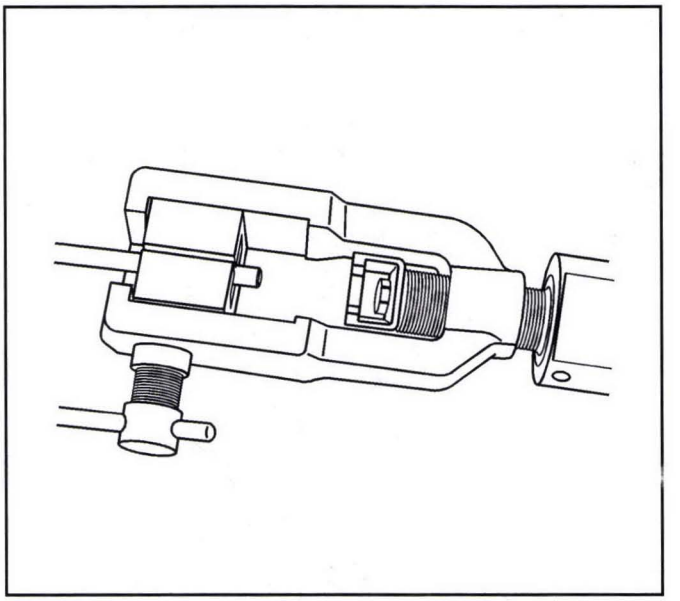
  – 6.35 mm (0.250 in) for 4.76 mm (3/16 in) diameter pipe

  – 9.50 mm (0.374 in) for 6.35 mm (1/4 in) and 7.94 mm (5/16 in) diameter pipe



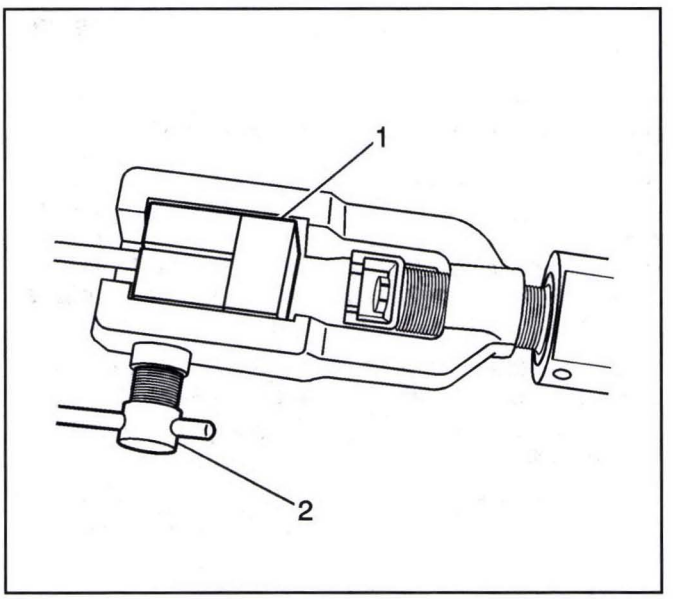
900947

10. Chamfer the inside and outside diameter of the pipe with the de-burring tool included in the *CH-45405* Brake Pipe Flaring Kit.
11. Install the tube nuts on the brake pipe, noting their orientation.
12. Clean the brake pipe and the *CH-45405* Brake Pipe Flaring Kit of lubricant, contaminants, and debris.



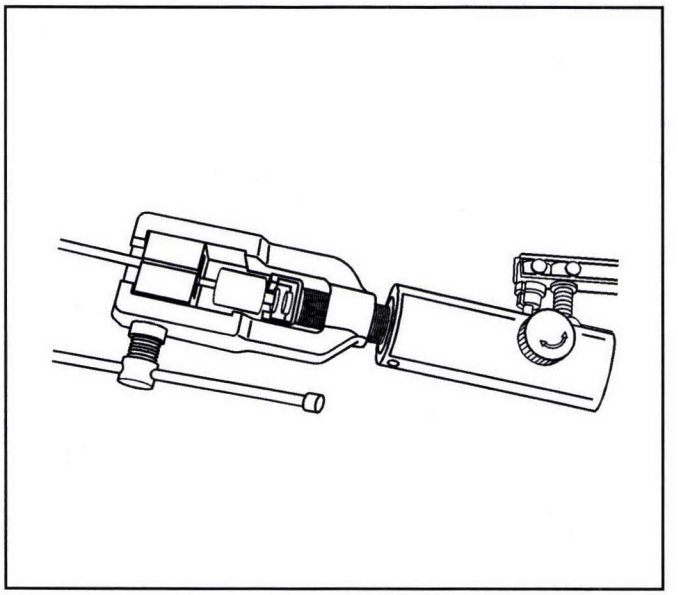
900942

13. Loosen the die clamping screw of the *CH-45405* Brake Pipe Flaring Kit.
14. Select the corresponding die set and install the die halves into the die cage with the full, flat face of one die facing the clamping screw, and the counterbores of both dies facing the forming ram.



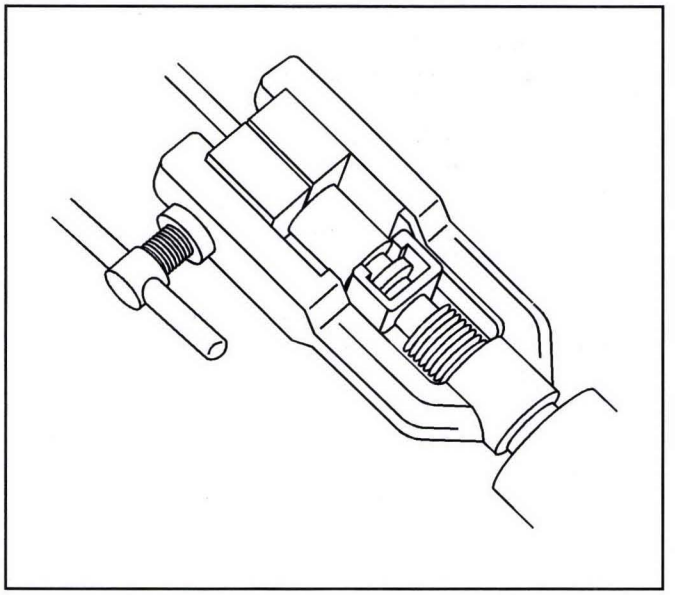
900943

15. Place the flat face of an unused die (1) against the die halves in the clamping cage and hold firmly against the counterbored face of the dies.
16. Insert the prepared end of the pipe to be flared through the back of the dies until the pipe is seated against the flat surface of the unused die (1).
17. Remove the unused die (1).
18. Ensure that the rear of both dies are seated firmly against the enclosed end of the die cage.
19. Firmly hand tighten the clamping screw (2) against the dies.



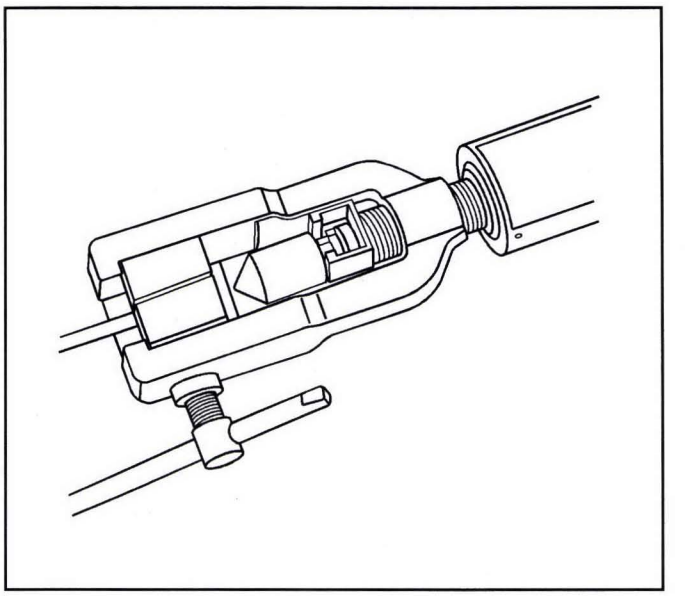
900944

20. Select the appropriate forming mandrel and place into the forming ram.
21. Rotate the hydraulic fluid control valve clockwise to the closed position.
22. Rotate the body of the *CH-45405* Brake Pipe Flaring Kit until it bottoms against the die cage.



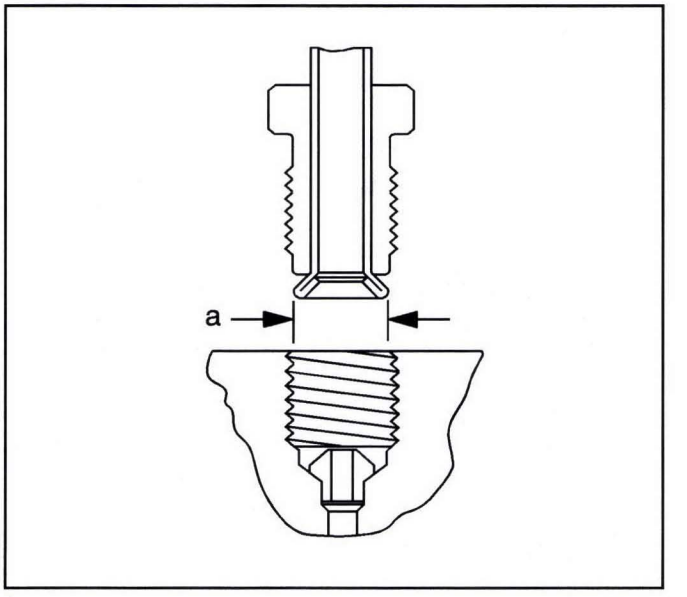
900946

23. While guiding the forming mandrel into the exposed end of pipe to be flared, operate the lever of the *CH-45405* Brake Pipe Flaring Kit until the forming mandrel bottoms against the clamping dies.
24. Rotate the hydraulic fluid control valve counterclockwise to the open position to allow the hydraulic forming ram to retract.



900948

25. Insert the finishing cone into the forming ram.
26. Rotate the hydraulic fluid control valve clockwise to the closed position.
27. Rotate the body of the *CH-45405* Brake Pipe Flaring Kit until it bottoms against the die cage.
28. While guiding the finishing cone into the exposed end of pipe to be flared, operate the lever of the *CH-45405* Brake Pipe Flaring Kit until the finishing cone bottoms against the dies.
29. Rotate the hydraulic fluid control valve counterclockwise to the open position to allow the hydraulic forming ram to retract.
30. Loosen the die clamping screw and remove the dies and pipe.
31. If necessary, lightly tap the dies until the die halves separate.



1201234

32. Inspect the brake pipe flare for correct shape and diameter (a).

    Specification

    - 6.74–7.10 mm (0.265–0.279 in) flare diameter for 4.76 mm (3/16 in) diameter pipe
    - 8.57–9.27 mm (0.344–0.358 in) flare diameter for 6.35 mm (1/4 in) diameter pipe
    - 10.42–10.79 mm (0.410–0.425 in) flare diameter for 7.94 mm (5/16 in) diameter pipe

33. If necessary, using the removed section of brake pipe as a template, shape the new pipe with a suitable brake pipe bending tool.

    Note: When installing the pipe, maintain a clearance of 19 mm (3/4 in) from all moving or vibrating components.

34. Install the pipe to the vehicle with the appropriate brake pipe unions, as required.
35. If previously released, secure the brake pipe to the retainers.
36. Bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*.
37. With the aid of an assistant, inspect the brake pipe flares for leaks by starting the engine and applying the brakes.

Rear Brake Front Pipe Replacement (Left)

Removal Procedure

Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

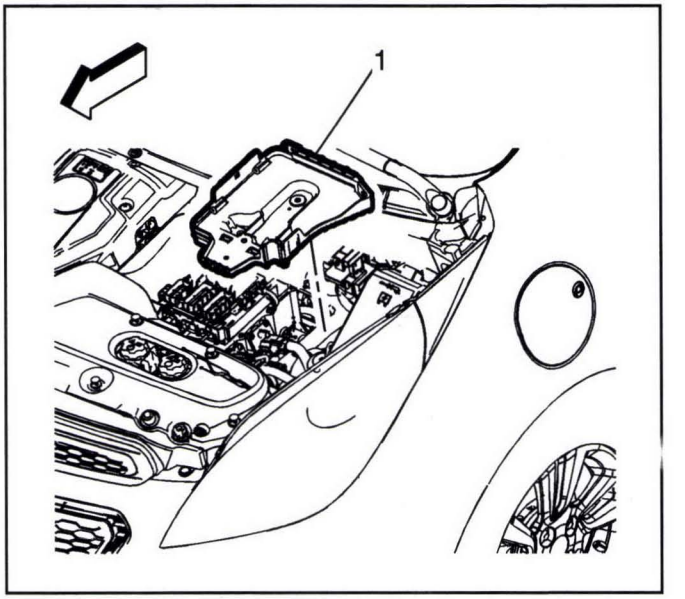
Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

Note: The transmission must be in the PARK position, the power button in the OFF position, and the brakes not applied to ensure the brake modulator and high pressure accumulator (HPA) pressure relief occurs. This process will take approximately 1 to 3 minutes.

1. Place the transmission in PARK.
2. Place the power button in the OFF position.
3. Remove the remote keyless entry (RKE) transmitter and close all of the vehicle doors.

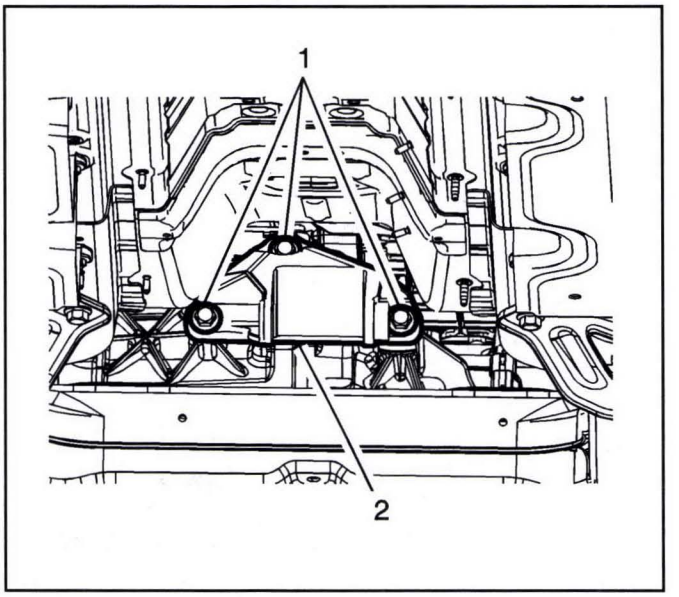
   Note: During the pressure relief process, the fluid level in the master cylinder reservoir will rise. Do not remove the master cylinder reservoir cap during the pressure relief process.

4. Wait approximately 3 minutes for the HPA pressure relief to occur.



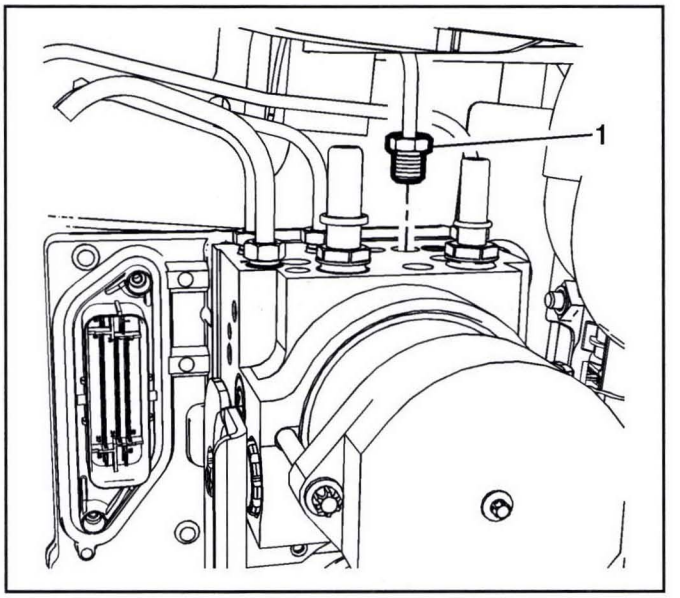
3216630

5. Remove the battery tray (1). Refer to *Battery Tray Replacement on page 9-30*.
6. Remove the heater coolant pump. Refer to *Heater Coolant Pump Replacement on page 10-56*.
7. Remove the front bumper impact bar. Refer to *Front Bumper Fascia Replacement on page 3-57*.
8. Remove the drive motor coolant radiator assembly. Refer to *Drive Motor Battery Coolant Radiator Replacement on page 9-312*.
9. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
10. Remove the right side underbody front air deflector. Refer to *Underbody Front Air Deflector Replacement - Right Side on page 3-128*.
11. Remove the left side front compartment front splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.
12. Remove the right drivetrain and front suspension frame stabilizer bracket. Refer to *Drivetrain and Front Suspension Frame Stabilizer Bracket Replacement on page 3-131*.



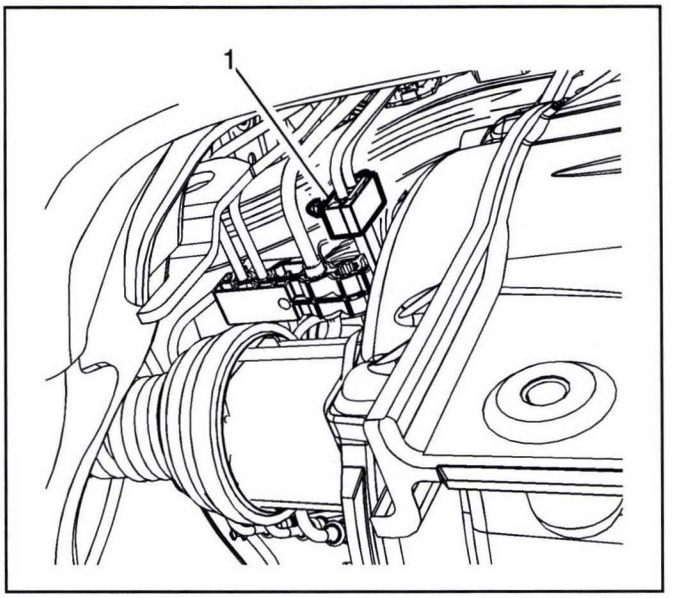
3139653

13. Remove the transmission rear mount bracket (2). Refer to *Transmission Rear Mount Bracket Replacement on page 16-50*.



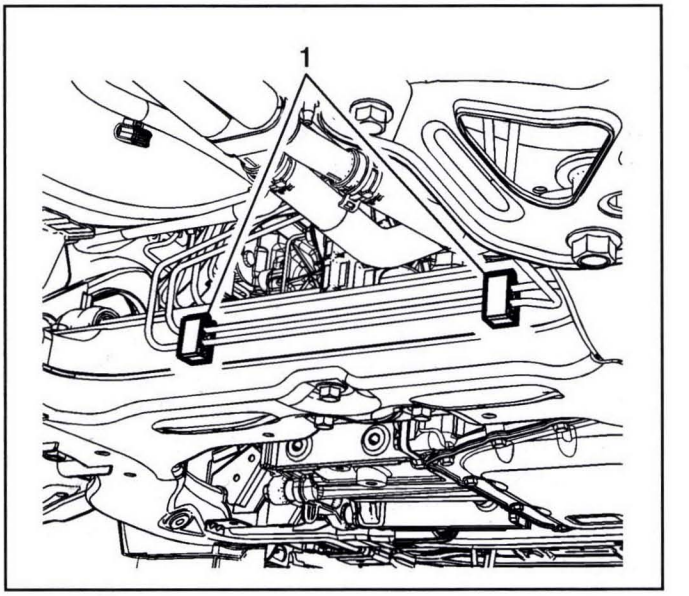
3225833

14. Disconnect the left rear brake front pipe fitting (1) from the electric hydraulic control unit (EHCU).
15. Plug the EHCU port to prevent brake fluid loss and contamination.



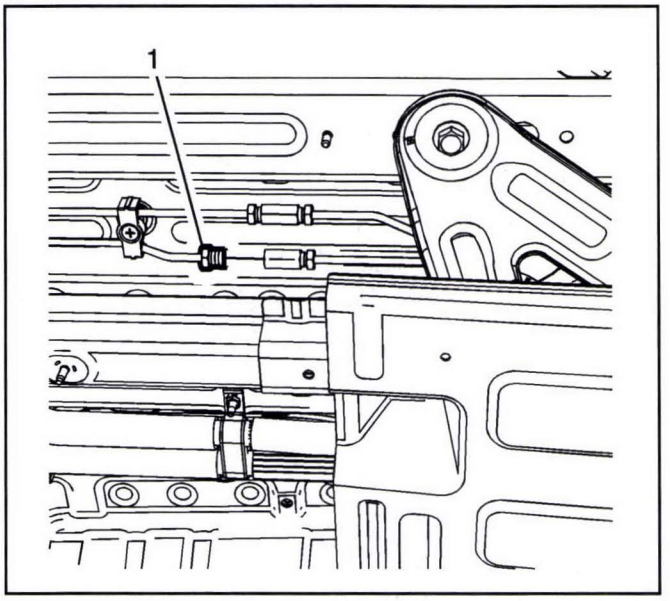
3225836

16. Release the left rear brake front pipe from the brake pipe retainer (1).



3225838

17. Release the left rear brake front pipe from the retainers (1) on the frame.

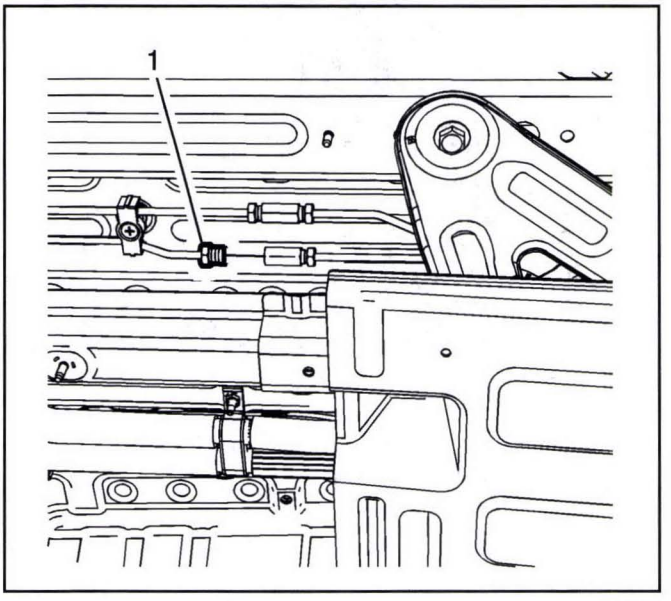


3225411

18. Disconnect the left rear brake pipe fitting (1) from the rear brake intermediate number 1 pipe union.
19. Plug the rear brake intermediate number 1 fitting pipe union to prevent brake fluid loss and contamination.
20. Remove the left rear brake pipe.

Installation Procedure

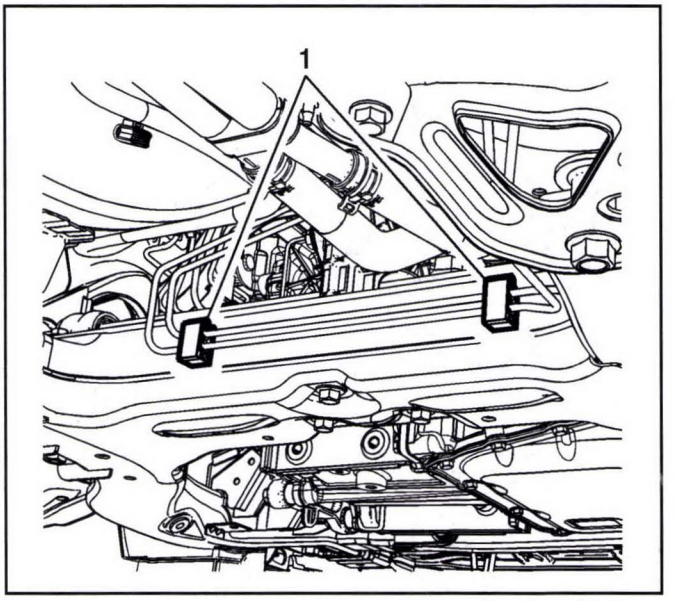
1. Install the left rear brake pipe.



3225411

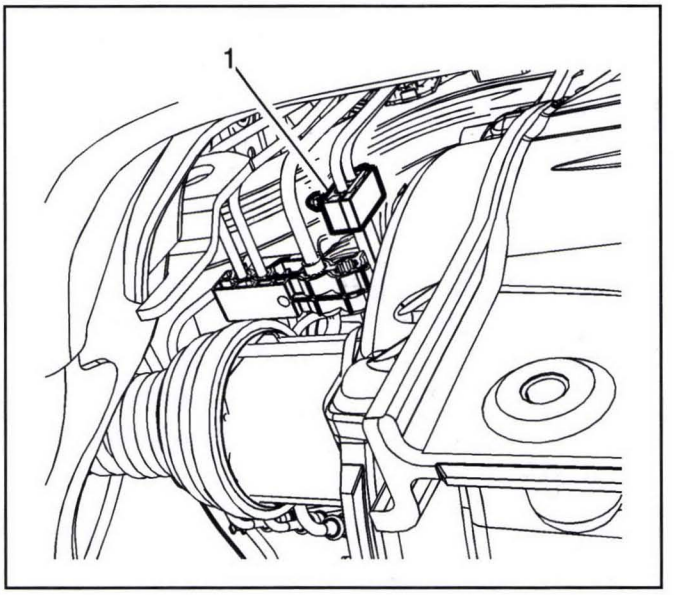
Caution: Refer to *Fastener Caution on page 0-8*.

2. Install the left rear brake pipe fitting (1) to the rear brake intermediate number 1 pipe union and tighten the fitting to **18 N•m (13 lb ft)**.



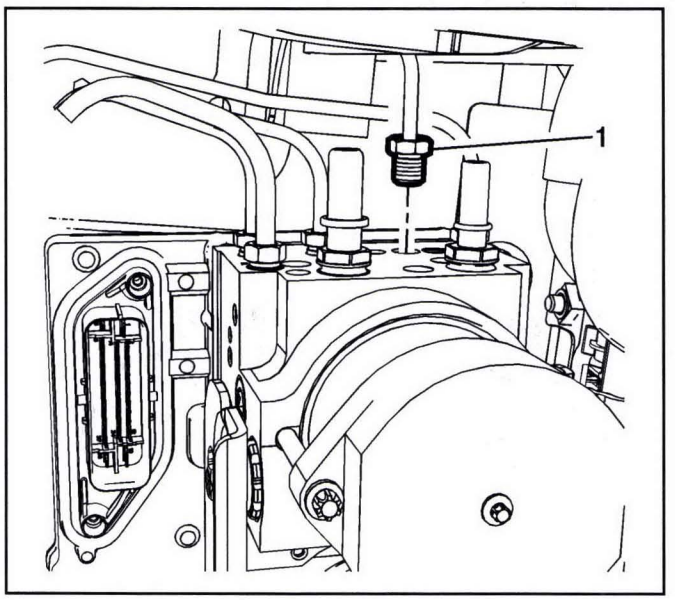
3225838

3. Install the left rear brake front pipe to the retainers (1) on the frame.



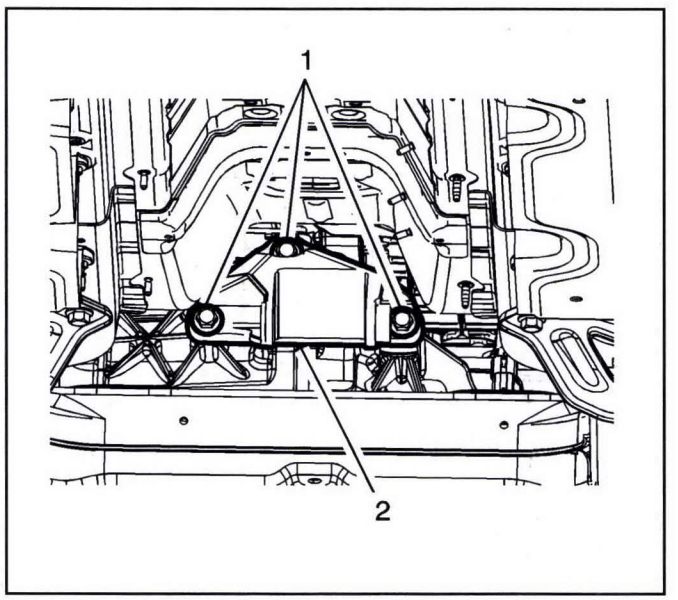
3225836

4. Install the left rear brake front pipe to the brake pipe retainer (1).



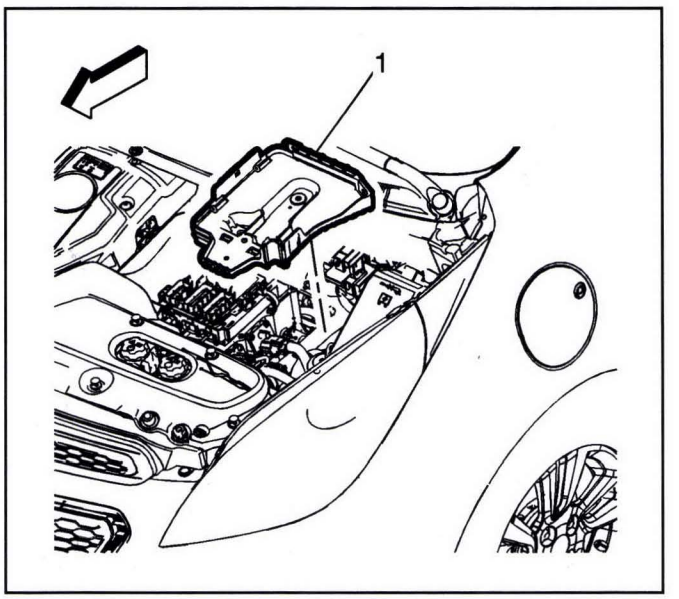
3225833

5. Install the left rear brake front pipe fitting (1) to the EHCU and tighten the fitting to **18 N•m (13 lb ft)**.



3139653

6. Install the transmission rear mount bracket (2). Refer to *Transmission Rear Mount Bracket Replacement on page 16-50*.
7. Install the right drivetrain and front suspension frame stabilizer bracket. Refer to *Drivetrain and Front Suspension Frame Stabilizer Bracket Replacement on page 3-131*.
8. Install the left front compartment front splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.
9. Install the right side underbody front air deflector. Refer to *Underbody Front Air Deflector Replacement - Right Side on page 3-128*.
10. Install the drive motor coolant radiator assembly. Refer to *Drive Motor Battery Coolant Radiator Replacement on page 9-312*.
11. Install the front bumper impact bar. Refer to *Front Bumper Fascia Replacement on page 3-57*.
12. Install the heater coolant pump. Refer to *Heater Coolant Pump Replacement on page 10-56*.



3216630

13. Install the battery tray (1). Refer to *Battery Tray Replacement on page 9-30*.
14. Bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*.

Rear Brake Front Pipe Replacement (Right)

Removal Procedure

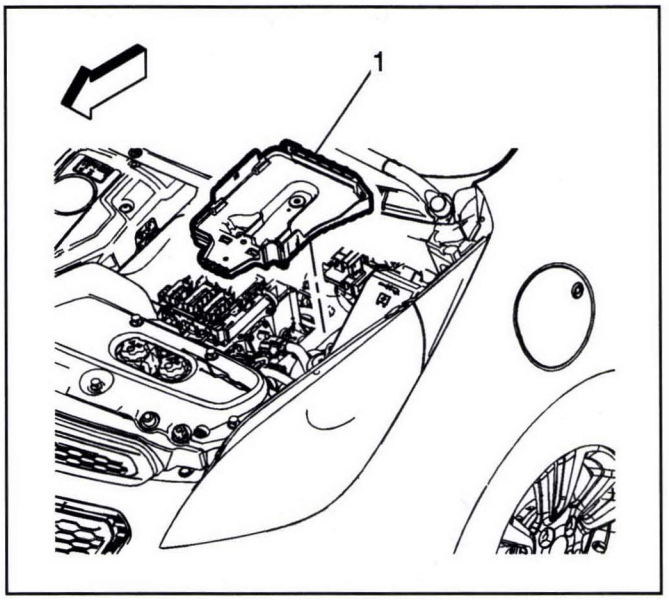
Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

Note: The transmission must be in the PARK position, the power button in the OFF position, and the brakes not applied to ensure the brake modulator and high pressure accumulator (HPA) pressure relief occurs. This process will take approximately 1 to 3 minutes.

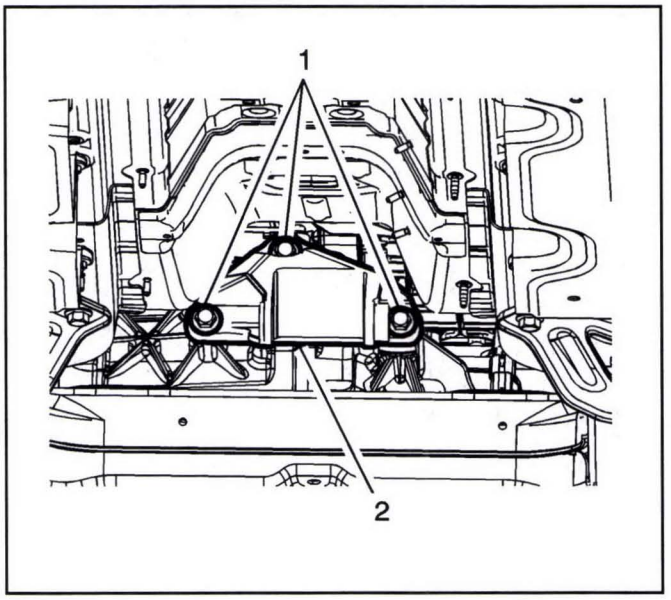
1. Place the transmission in PARK.
2. Place the power button in the OFF position.
3. Remove the remote keyless entry (RKE) transmitter and close all of the vehicle doors.

   Note: During the pressure relief process, the fluid level in the master cylinder reservoir will rise. Do not remove the master cylinder reservoir cap during the pressure relief process.
4. Wait approximately 3 minutes for the HPA pressure relief to occur.



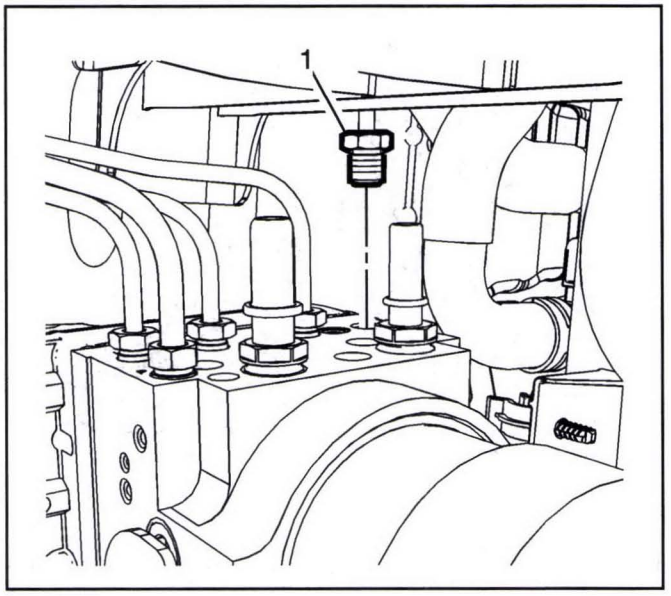
3216630

5. Remove the battery tray (1). Refer to *Battery Tray Replacement on page 9-30*.
6. Remove the heater coolant pump. Refer to *Heater Coolant Pump Replacement on page 10-56*.
7. Remove the front bumper impact bar. Refer to *Front Bumper Fascia Replacement on page 3-57*.
8. Remove the drive motor coolant radiator assembly. Refer to *Drive Motor Battery Coolant Radiator Replacement on page 9-312*.
9. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
10. Remove the right side underbody front air deflector. Refer to *Underbody Front Air Deflector Replacement - Right Side on page 3-128*.
11. Remove the left side front compartment front splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.
12. Remove the right drivetrain and front suspension frame stabilizer bracket. Refer to *Drivetrain and Front Suspension Frame Stabilizer Bracket Replacement on page 3-131*.



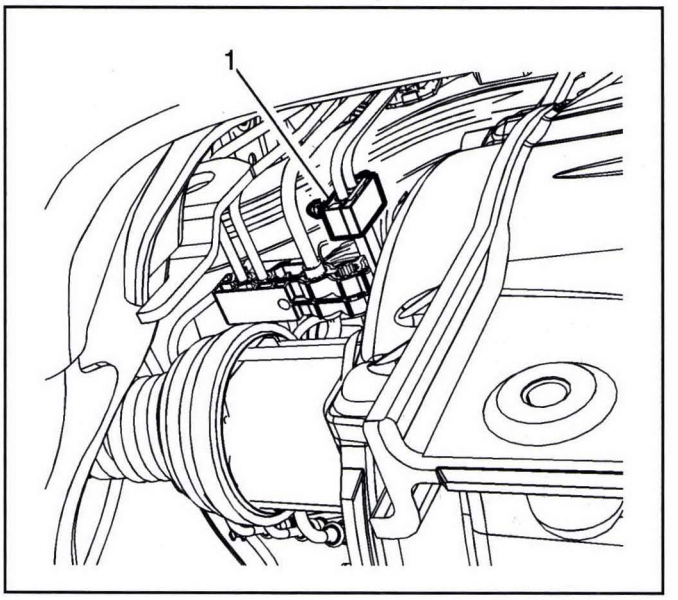
3139653

13. Remove the transmission rear mount bracket (2). Refer to *Transmission Rear Mount Bracket Replacement on page 16-50*.



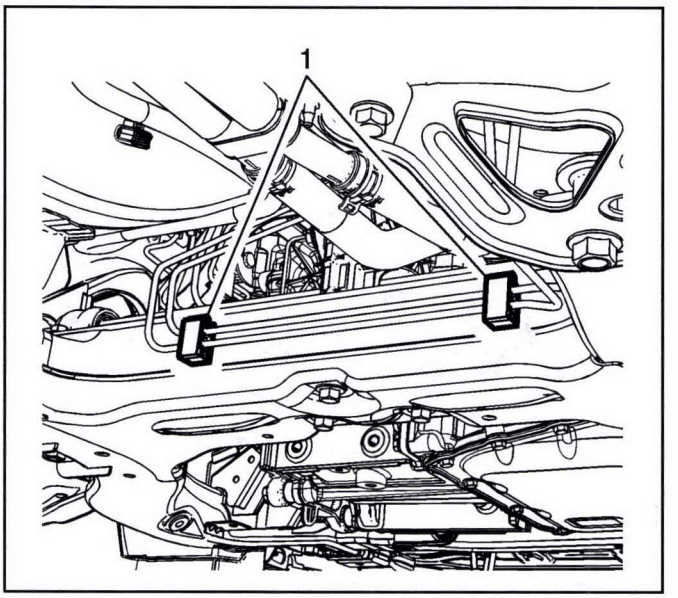
3225839

14. Disconnect the right rear brake front pipe fitting (1) from the electric hydraulic control unit (EHCU).
15. Plug the EHCU port to prevent brake fluid loss and contamination.



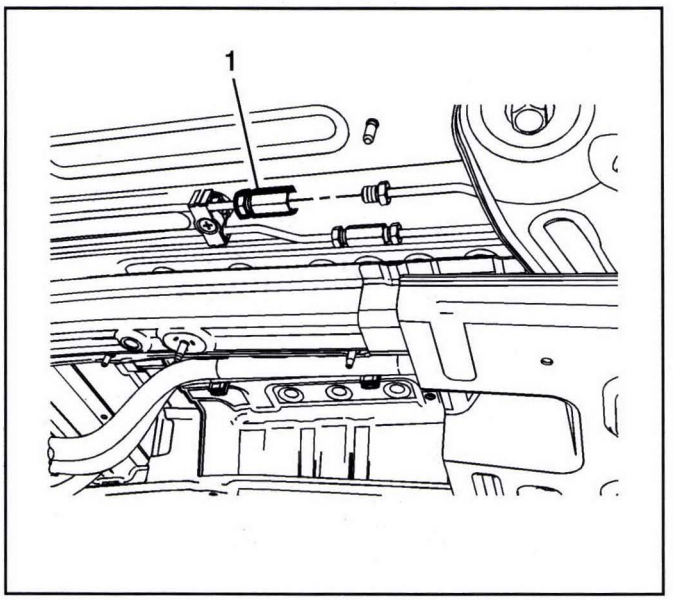
3225836

16. Release the right rear brake front pipe from the brake pipe retainer (1).



3225838

17. Release the right rear brake front pipe from the retainers (1) on the frame.

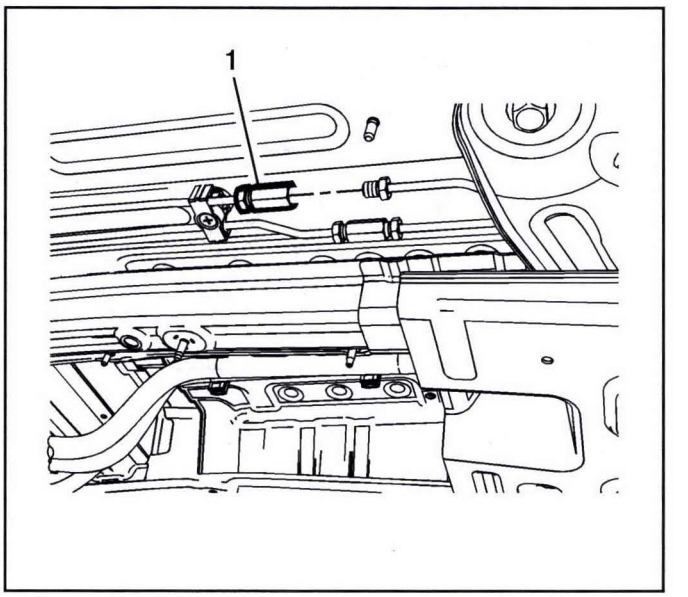


3225645

18. Disconnect the right rear brake pipe union (1) from the rear brake intermediate number 2 pipe fitting.
19. Plug the rear brake intermediate number 1 fitting pipe union to prevent brake fluid loss and contamination.
20. Remove the right rear brake pipe.

Installation Procedure

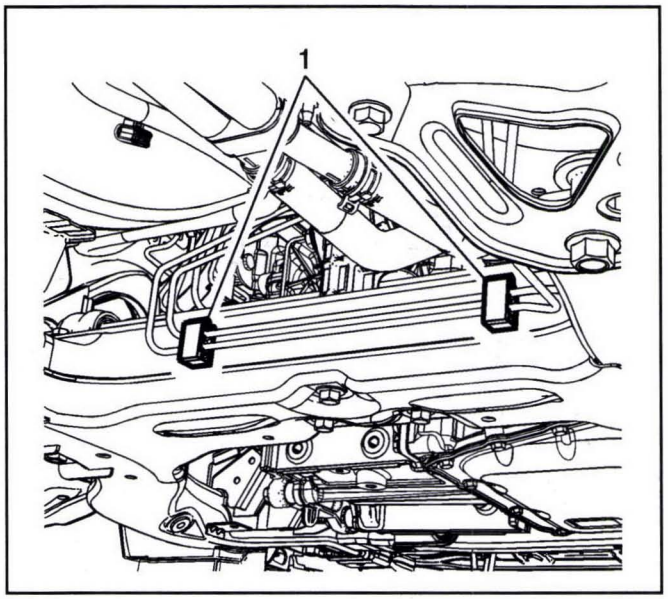
1. Install the right rear brake pipe.



3225645

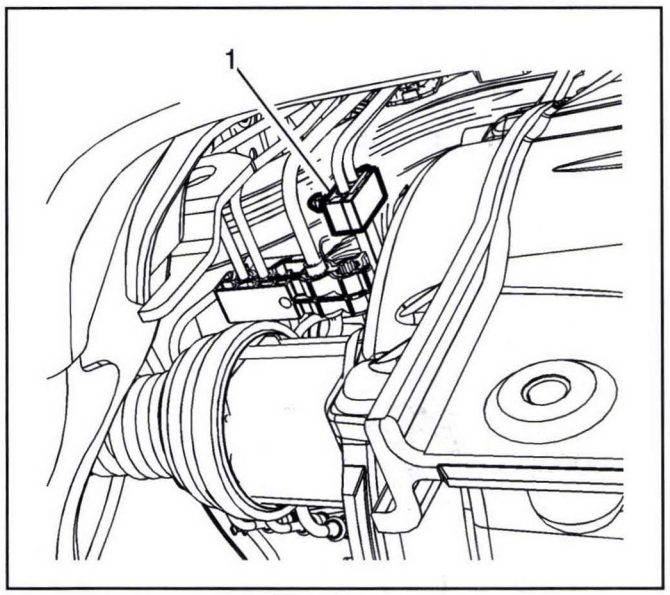
Caution: Refer to *Fastener Caution on page 0-8*.

2. Install the right rear brake pipe union (1) to the rear brake intermediate number 1 pipe union and tighten the fitting to **18** N•m **(13 lb ft)**.



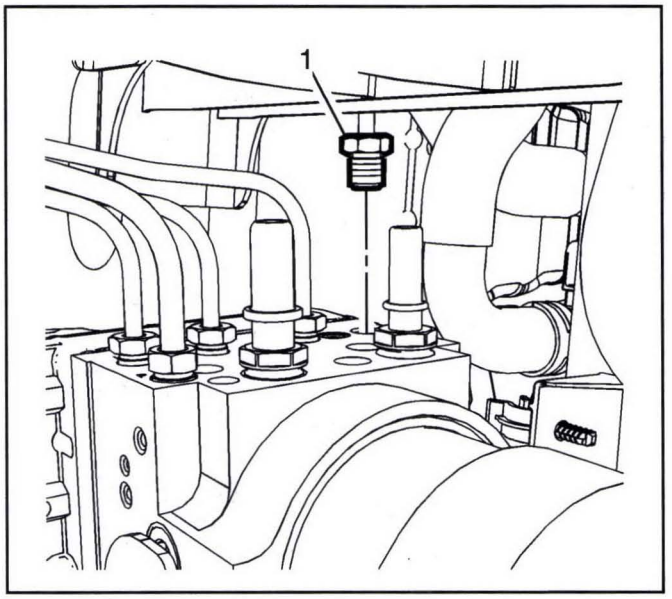
3225838

3. Install the right rear brake front pipe to the retainers (1) on the frame.



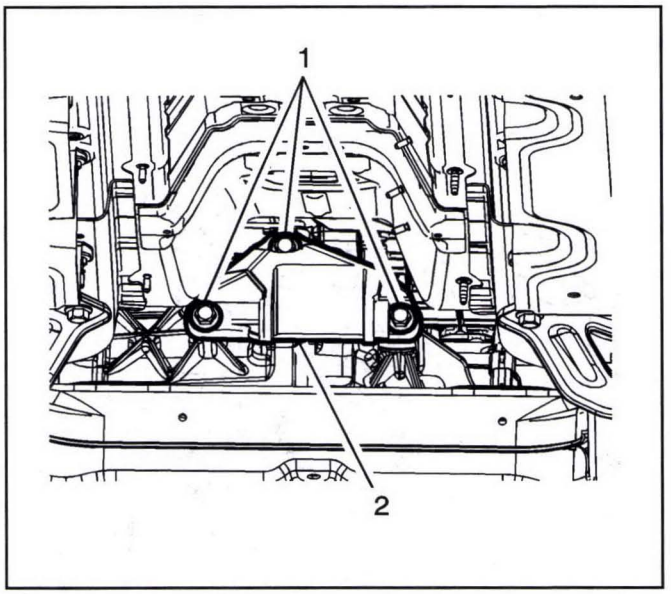
3225836

4. Install the right rear brake front pipe to the brake pipe retainer (1).



3225839

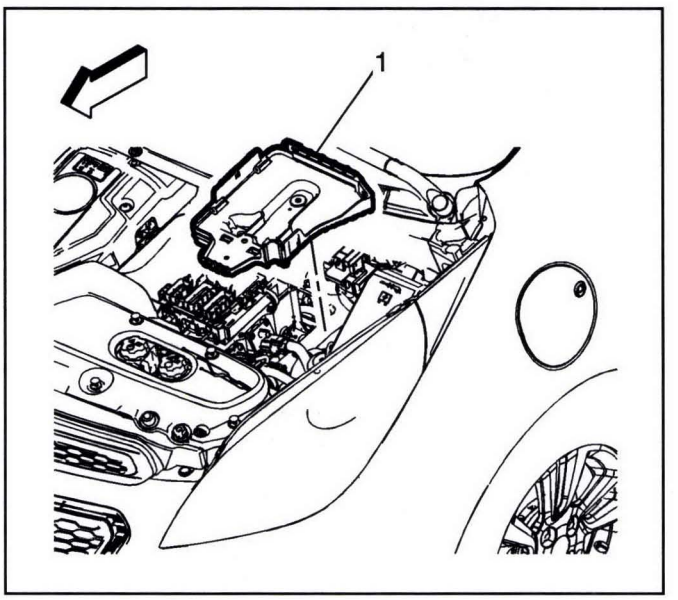
5. Install the right rear brake front pipe fitting (1) to the EHCU and tighten the fitting to **18 N•m (13 lb ft)**.



3139653

6. Install the transmission rear mount bracket (2). Refer to *Transmission Rear Mount Bracket Replacement on page 16-50*.
7. Install the right drivetrain and front suspension frame stabilizer bracket. Refer to *Drivetrain and Front Suspension Frame Stabilizer Bracket Replacement on page 3-131*.
8. Install the left front compartment front splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.
9. Install the right side underbody front air deflector. Refer to *Underbody Front Air Deflector Replacement - Right Side on page 3-128*.

10. Install the drive motor coolant radiator assembly. Refer to *Drive Motor Battery Coolant Radiator Replacement on page 9-312*.
11. Install the front bumper impact bar. Refer to *Front Bumper Fascia Replacement on page 3-57*.
12. Install the heater coolant pump. Refer to *Heater Coolant Pump Replacement on page 10-56*.



3216630

13. Install the battery tray (1). Refer to *Battery Tray Replacement on page 9-30*.
14. Bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*.

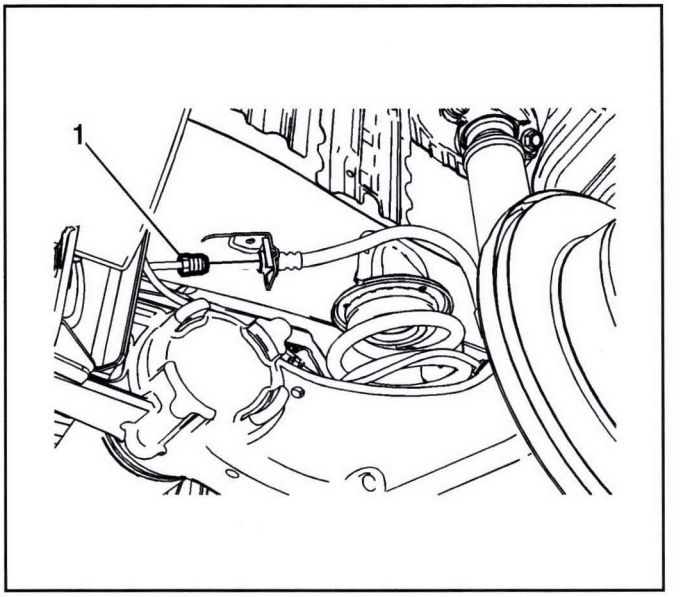
Rear Brake Hose Replacement

Removal Procedure

Warning: Refer to Brake Dust Warning on page 0-4.

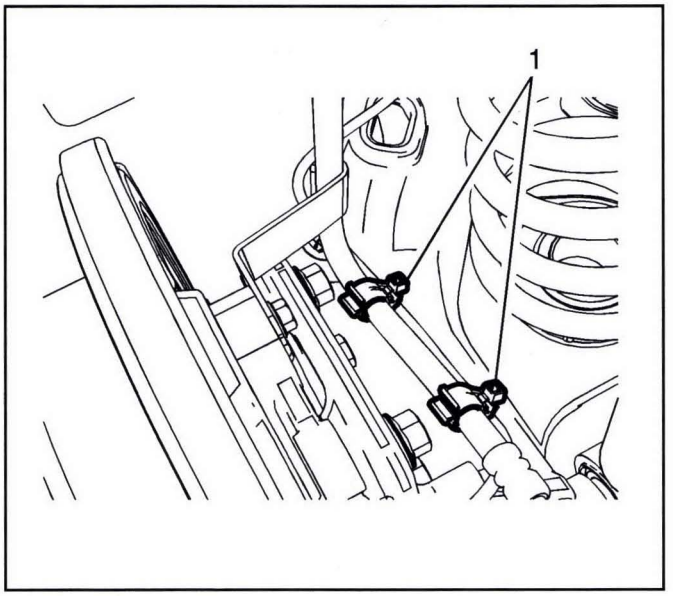
Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.



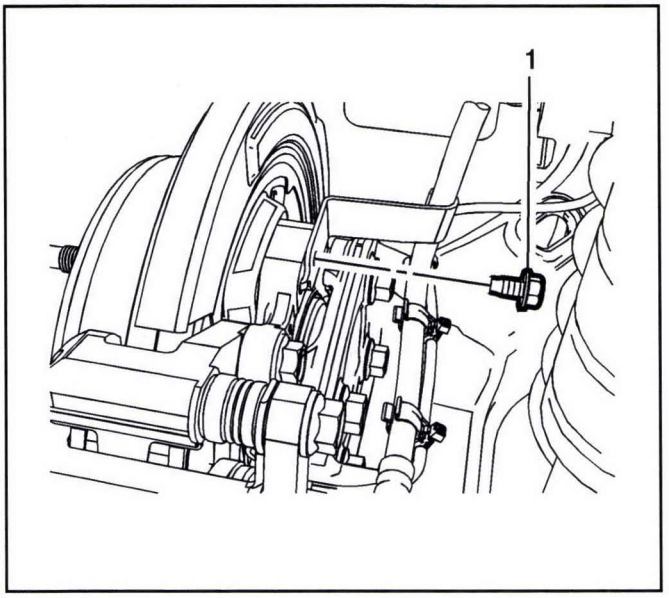
3226041

3. Disconnect the brake pipe fitting (1) from the brake hose.
4. Cap the brake pipe fitting to prevent brake fluid loss and contamination.



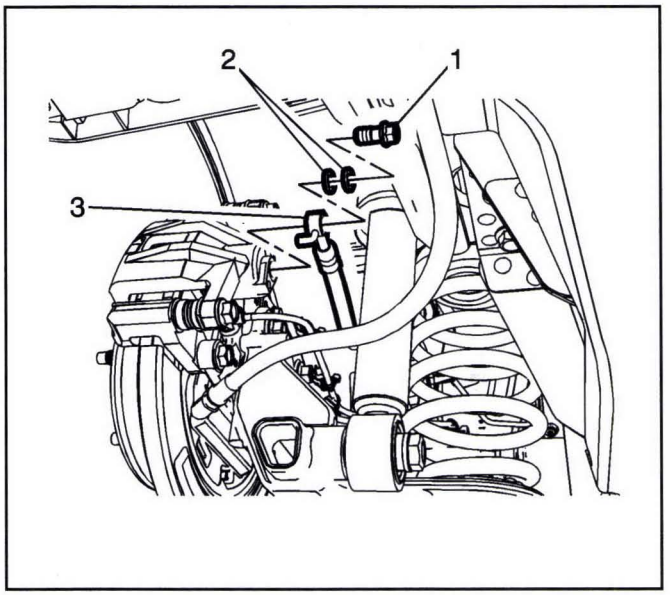
3227704

5. Release the rear wheel speed sensor harness clips (1) from the brake hose.



3227991

6. Remove the brake hose bracket bolt (1).

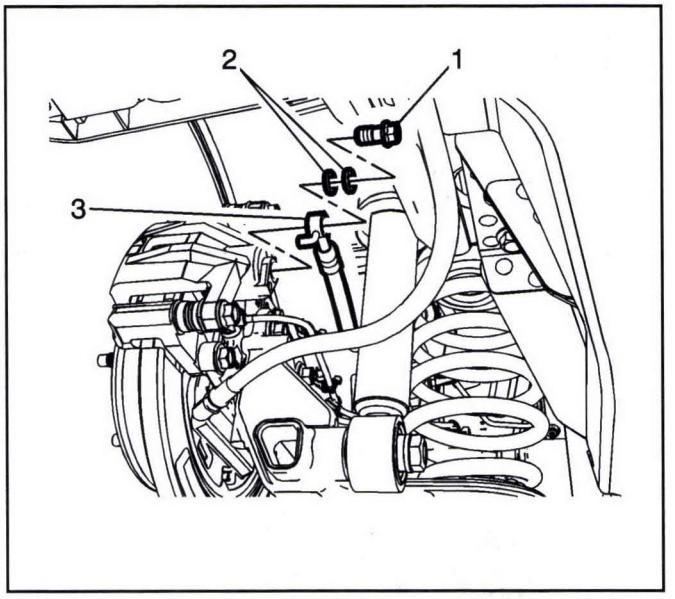


3034099

7. Remove the brake hose fitting bolt (1).
   Note: Do not reuse the brake hose fitting gaskets.
8. Remove and discard the brake hose fitting gaskets (2) from the brake hose fitting (3).
9. Remove the brake hose from the vehicle.

Installation Procedure

1. Install the brake hose to the vehicle.

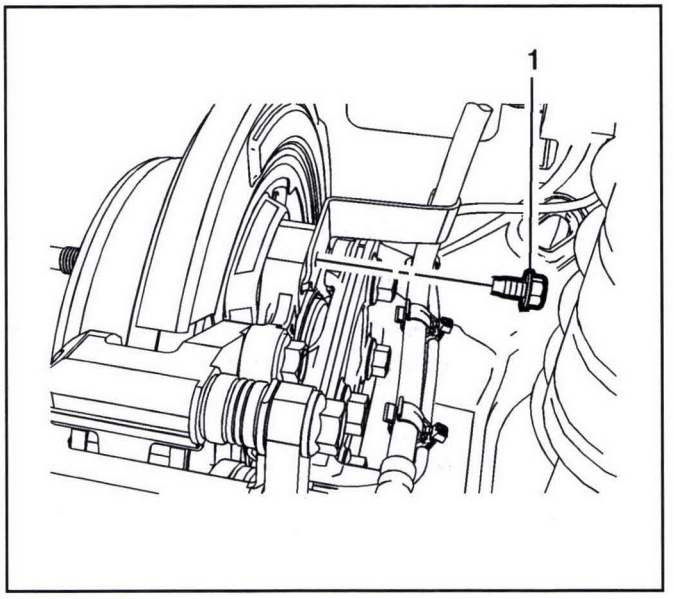


3034099

2. Assemble the brake hose fitting bolt (1) and the new brake hose fitting gaskets (2) to the brake hose (3).

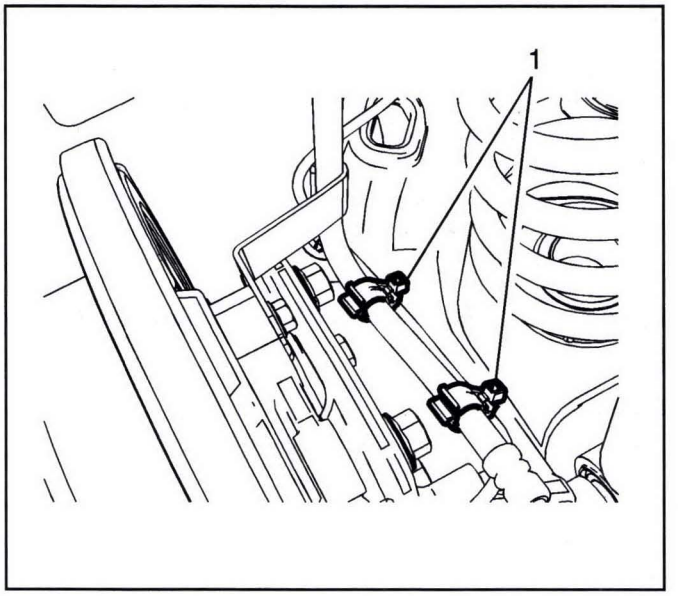
Caution: Refer to *Fastener Caution on page 0-8*.

3. Install the brake hose assembly to the caliper and tighten the brake hose fitting bolt to **40** N•m **(30 lb ft)**.



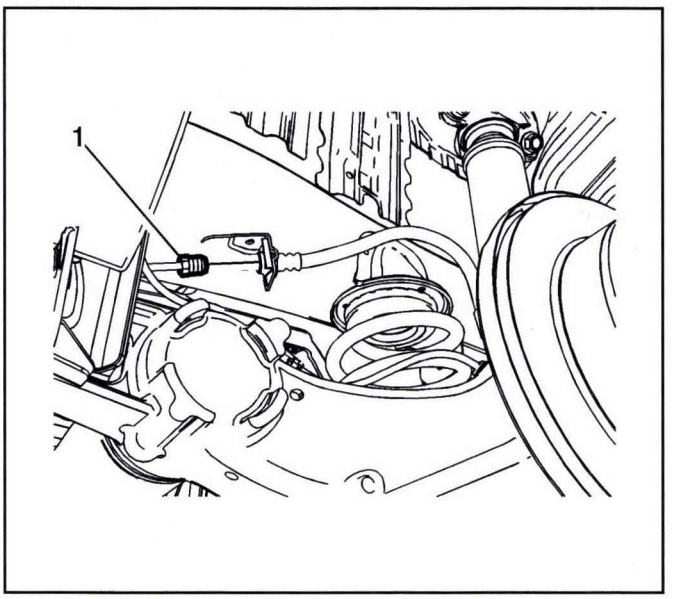
3227991

4. Install the brake hose bracket bolt (1) and tighten the bolt to **9** N•m **(80 lb in)**.



3227704

5. Install the rear wheel speed sensor harness clips (1) to the brake hose.



3226041

6. Install the brake pipe fitting (1) to the brake hose and tighten the brake pipe fitting to **18 N•m (13 lb ft)**.
7. Bleed the hydraulic brake system. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*.
8. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.

Hydraulic Brake System Bleeding (Manual)

Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

1. Place a clean shop cloth beneath the brake master cylinder to prevent brake fluid spills.
2. With the ignition OFF and the brakes cool, apply the brakes 3–5 times, or until the brake pedal effort increases significantly, in order to deplete the brake booster power reserve.
3. If you have performed a brake master cylinder bench bleeding on this vehicle, or if you disconnected the brake pipes from the master cylinder, you must perform the following steps:
   3.1. Ensure that the brake master cylinder reservoir is full to the maximum-fill level. If necessary add GM approved brake fluid from a clean, sealed brake fluid container. Refer to *Fluid and Lubricant Recommendations on page 1-32*.

   If removal of the reservoir cap and diaphragm is necessary, clean the outside of the reservoir on and around the cap prior to removal.

   3.2. With the rear brake pipe installed securely to the master cylinder, loosen and separate the front brake pipe from the front port of the brake master cylinder.
   3.3. Allow a small amount of brake fluid to gravity bleed from the open port of the master cylinder.
   3.4. Reconnect the brake pipe to the master cylinder port and tighten securely.
   3.5. Have an assistant slowly depress the brake pedal fully and maintain steady pressure on the pedal.
   3.6. Loosen the same brake pipe to purge air from the open port of the master cylinder.
   3.7. Tighten the brake pipe, then have the assistant slowly release the brake pedal.
   3.8. Wait 15 seconds, then repeat steps 3.3–3.7 until all air is purged from the same port of the master cylinder.
   3.9. With the front brake pipe installed securely to the master cylinder, after all air has been purged from the front port of the master cylinder, loosen and separate the rear brake pipe from the master cylinder, then repeat steps 3.3–3.8.
   3.10. After completing the final master cylinder port bleeding procedure, ensure that both of the brake pipe-to-master cylinder fittings are properly tightened.
4. Fill the brake master cylinder reservoir with GM approved brake fluid from a clean, sealed brake fluid container. Refer to *Master Cylinder Reservoir Filling on page 5-165*. Ensure that the brake master cylinder reservoir remains at least half-full during this bleeding procedure. Add fluid as needed to maintain the proper level.

Clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.

5. Install a proper box-end wrench onto the RIGHT REAR wheel hydraulic circuit bleeder valve.
6. Install a transparent hose over the end of the bleeder valve.
7. Submerge the open end of the transparent hose into a transparent container partially filled with GM approved brake fluid from a clean, sealed brake fluid container. Refer to *Fluid and Lubricant Recommendations on page 1-32*.
8. Have an assistant slowly depress the brake pedal fully and maintain steady pressure on the pedal.
9. Loosen the bleeder valve to purge air from the wheel hydraulic circuit.
10. Tighten the bleeder valve, then have the assistant slowly release the brake pedal.
11. Wait 15 seconds, then repeat steps 8–10 until all air is purged from the same wheel hydraulic circuit.
12. With the right rear wheel hydraulic circuit bleeder valve tightened securely, after all air has been purged from the right rear hydraulic circuit install a proper box-end wrench onto the LEFT REAR wheel hydraulic circuit bleeder valve.
13. Install a transparent hose over the end of the bleeder valve, then repeat steps 7–11.
14. With the left rear wheel hydraulic circuit bleeder valve tightened securely, after all air purged from the left rear hydraulic circuit, install a proper box-end wrench onto the RIGHT FRONT wheel hydraulic circuit bleeder valve.
15. Install a transparent hose over the end of the bleeder valve, then repeat steps 7–11.
16. With the right front wheel hydraulic circuit bleeder valve tightened securely, after all air has been purged from the right front hydraulic circuit, install a proper box-end wrench onto the LEFT FRONT wheel hydraulic circuit bleeder valve.
17. Install a transparent hose over the end of the bleeder valve, then repeat steps 7–11.
18. After completing the final wheel hydraulic circuit bleeding procedure, ensure that each of the 4 wheel hydraulic circuit bleeder valves are properly tightened.
19. Fill the brake master cylinder reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to *Master Cylinder Reservoir Filling on page 5-165*.
20. Slowly depress and release the brake pedal. Observe the feel of the brake pedal.
21. If the brake pedal feels spongy, repeat the bleeding procedure again. If the brake pedal still feels spongy after repeating the bleeding procedure, perform the following steps:
    21.1. Inspect the brake system for external leaks. Refer to *Brake System External Leak Inspection on page 5-162*.
    21.2. Pressure bleed the hydraulic brake system in order to purge any air that may still be trapped in the system.
22. Turn the ignition key ON, with the engine OFF. Check to see if the brake system warning lamp remains illuminated.

    Note: If the brake system warning lamp remains illuminated, DO NOT allow the vehicle to be driven until it is diagnosed and repaired.
23. If the brake system warning lamp remains illuminated, refer to *Symptoms - Hydraulic Brakes on page 5-136*.

Hydraulic Brake System Bleeding (Pressure)

Special Tools

- *CH-29532-A* Brake Pressure Bleeder, or equivalent
- *CH-44894-A* Brake Pressure Bleeder Adapter

For equivalent regional tools, refer to *Special Tools on page 5-219*.

Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

Caution: Only use products that comply with GM specifications and check manufacturer information respectively. We recommend the use of GM genuine products. Instructions must be followed at all times. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.

Note: The transmission must be in the PARK position, the power button in the OFF position, and the brakes not applied to ensure the brake modulator and high pressure accumulator (HPA) pressure relief occurs. This process will take approximately 1 to 3 minutes.

1. Place the transmission in PARK.
2. Apply and release the brake pedal.
3. Place the power button in the OFF position.
4. Remove the remote keyless entry (RKE) transmitter and close all of the vehicle doors.
5. Place a clean shop cloth beneath the brake master cylinder to prevent brake fluid spills.

   Note: Clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.
6. Fill the brake master cylinder reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to *Adhesives, Fluids, Lubricants, and Sealers on page 5-133*.
7. Install the *CH-44894-A* Brake Pressure Bleeder Adapter to the brake master cylinder reservoir.

8. Check the brake fluid level in the *CH-29532-A* Brake Pressure Bleeder, or equivalent. Add GM approved brake fluid from a clean, sealed brake fluid container as necessary to bring the level to approximately the half-full point. Refer to *Adhesives, Fluids, Lubricants, and Sealers on page 5-133*.
9. Connect the *CH-29532-A* Brake Pressure Bleeder, or equivalent, to the *CH-44894-A* Brake Pressure Bleeder Adapter.
10. Charge the *CH-29532-A* Brake Pressure Bleeder, or equivalent, air tank to 175–205 kPa (25–30 psi).
11. Open the *CH-29532-A* Brake Pressure Bleeder, or equivalent, fluid tank valve to allow pressurized brake fluid to enter the brake system.
12. Wait approximately 30 seconds, then inspect the entire hydraulic brake system in order to ensure that there are no existing external brake fluid leaks.

    Note: Any brake fluid leaks identified require repair prior to completing this procedure.
13. Install a proper box-end wrench onto the RIGHT REAR wheel hydraulic circuit bleeder valve.
14. Install a transparent hose over the end of the bleeder valve.
15. Submerge the open end of the transparent hose into a transparent container partially filled GM approved brake fluid from a clean, sealed brake fluid container. Refer to *Adhesives, Fluids, Lubricants, and Sealers on page 5-133*.
16. Loosen the bleeder valve to purge air from the wheel hydraulic circuit. Allow fluid to flow until air bubbles stop flowing from the bleeder, then tighten the bleeder valve.
17. With the right rear wheel hydraulic circuit bleeder valve tightened securely, after all air has been purged from the right rear hydraulic circuit, install a proper box-end wrench onto the LEFT REAR wheel hydraulic circuit bleeder valve.
18. Install a transparent hose over the end of the bleeder valve, then repeat steps 16–17.
19. With the left rear wheel hydraulic circuit bleeder valve tightened securely, after all air has been purged from the left rear hydraulic circuit, install a proper box-end wrench onto the RIGHT FRONT wheel hydraulic circuit bleeder valve.
20. Install a transparent hose over the end of the bleeder valve, then repeat steps 16–17.
21. With the right front wheel hydraulic circuit bleeder valve tightened securely, after all air has been purged from the right front hydraulic circuit, install a proper box-end wrench onto the LEFT FRONT wheel hydraulic circuit bleeder valve.
22. Install a transparent hose over the end of the bleeder valve, then repeat steps 16–17.
23. After completing the final wheel hydraulic circuit bleeding procedure, ensure that each of the 4 wheel hydraulic circuit bleeder valves are properly tightened.
24. Close the *CH-29532-A* Brake Pressure Bleeder, or equivalent, fluid tank valve, then disconnect the *CH-29532-A* Brake Pressure Bleeder, or equivalent, from the *CH-44894-A* Brake Pressure Bleeder Adapter.
25. Remove the *CH-44894-A* Brake Pressure Bleeder Adapter from the brake master cylinder reservoir.
26. Fill the brake master cylinder reservoir. Refer to *Master Cylinder Reservoir Filling on page 5-165*.
27. Slowly depress and release the brake pedal. Observe the feel of the brake pedal.
28. If the brake pedal feels spongy perform the following steps:
    28.1. Inspect the brake system for external leaks. Refer to *Brake System External Leak Inspection on page 5-162*.
    28.2. Using a scan tool, perform the antilock brake system automated bleeding procedure to remove any air that may have been trapped in the brake pressure modulator valve (BPMV). Refer to *Antilock Brake System Automated Bleed on page 5-72*.
29. Turn the power button ON. Check to see if the brake system warning lamp remains illuminated.

    Note: If the brake system warning lamp remains illuminated, DO NOT allow the vehicle to be driven until it is diagnosed and repaired.
30. If the brake system warning lamp remains illuminated, refer to *Symptoms - Hydraulic Brakes on page 5-136*.

Hydraulic Brake System Flushing

Warning: Refer to Brake Fluid Irritant Warning on page 0-4.

Caution: Refer to *Brake Fluid Effects on Paint and Electrical Components Caution on page 0-7*.

Caution: Only use products that comply with GM specifications and check manufacturer information respectively. We recommend the use of GM genuine products. Instructions must be followed at all times. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.

1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination:
   - Fluid separation, indicating two types of fluid are present; a substance other than the recommended brake fluid has been introduced into the brake hydraulic system
     - Swirled appearance — oil-based substance
     - Layered appearance — silicone-based substance
   - Fluid discoloration, indicating the presence of moisture or particles that have been introduced into the brake hydraulic system
     - Cloudy appearance — moisture
     - Dark appearance/suspended particles in fluid — dirt, rust, corrosion, brake dust

2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating brake fluid contamination.
3. If the brake fluid WAS contaminated with an oil-based or a silicone-based substance, indicated by fluid separation and/or a swollen master cylinder reservoir cap diaphragm and/or swollen reservoir-to-master cylinder grommets, perform the following:
   3.1. Remove ALL of the following components listed from the vehicle. Each component contains internal rubber seals/linings which have been contaminated by the contaminated brake fluid in the brake hydraulic system.

   Refer to the procedures indicated as applicable:
   - *Master Cylinder Replacement on page 5-168*
   - *Front Brake Hose Replacement on page 5-192*
   - *Rear Brake Hose Replacement on page 5-209*
   - *Front Brake Caliper Replacement on page 5-108*
   - *Rear Brake Caliper Replacement on page 5-109*
   - *Brake Pressure Modulator Valve Replacement on page 5-76*

   3.2. Clean out all the hydraulic brake pipes using denatured alcohol, or equivalent.

   3.3. Dry the brake pipes using non-lubricated, filtered air.

   3.4. Repair or replace ALL of the following components listed and install them to the vehicle. Each component contains internal rubber seals/linings which have been contaminated by the contaminated brake fluid in the brake hydraulic system.

   Refer to the procedures indicated as applicable:
   - *Master Cylinder Replacement on page 5-168* ; also perform the following:

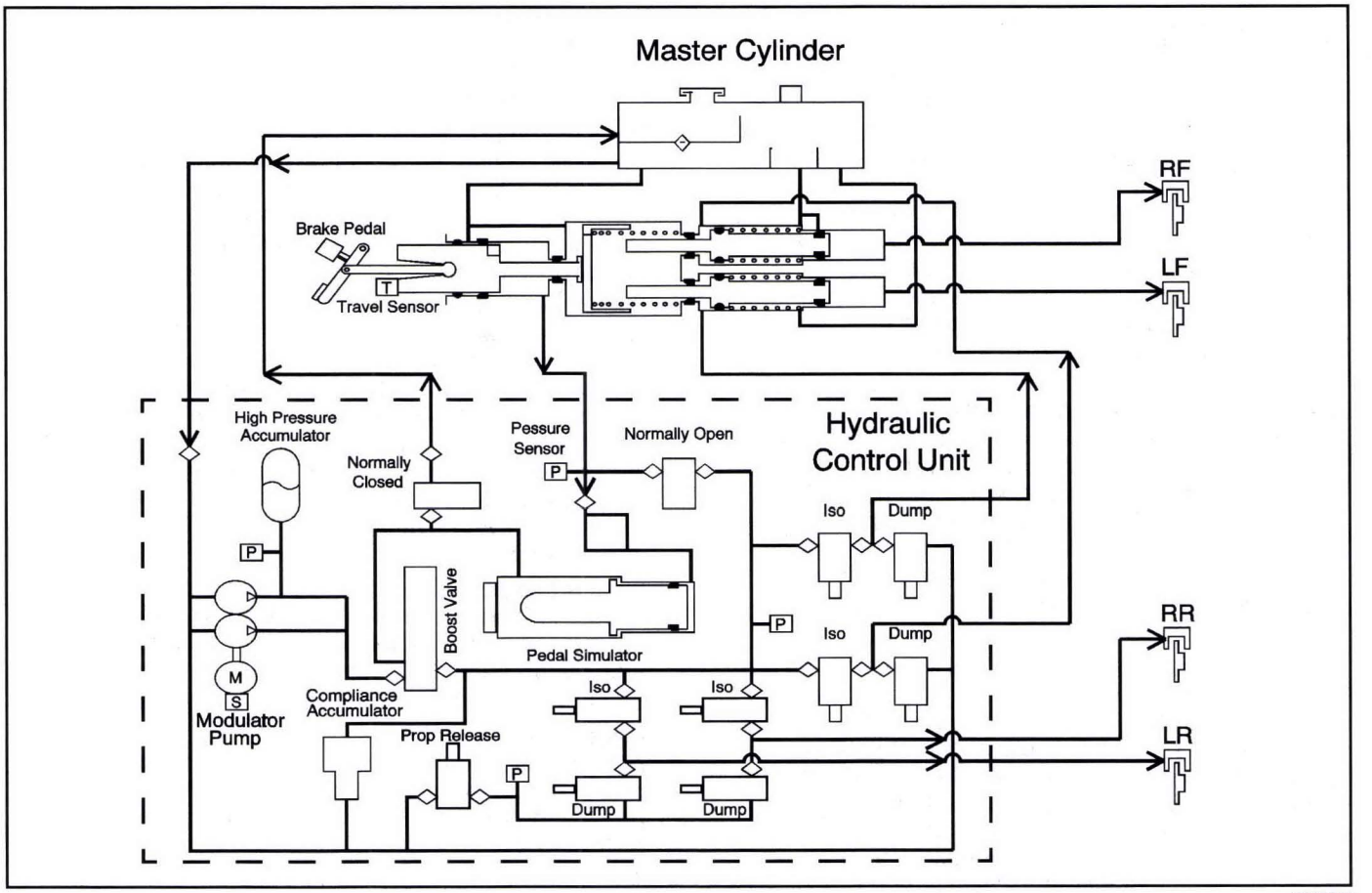
     Clean the brake master cylinder reservoir using denatured alcohol, or equivalent, then dry the reservoir using non-lubricated, filtered air. Inspect the reservoir for cracks and/or damage and replace if necessary. Refer to *Master Cylinder Reservoir Replacement on page 5-165*.

     Replace the brake master cylinder reservoir cap diaphragm.
   - *Front Brake Hose Replacement on page 5-192*
   - *Rear Brake Hose Replacement on page 5-209*
   - *Front Brake Caliper Overhaul on page 5-110* or *Front Brake Caliper Replacement on page 5-108*
   - *Rear Brake Caliper Overhaul on page 5-113* or *Rear Brake Caliper Replacement on page 5-109*
   - *Brake Pressure Modulator Valve Replacement on page 5-76*
4. If the brake fluid was NOT contaminated with an oil-based or a silicone-based substance, but WAS contaminated with water or dirt, rust, corrosion, and/or brake dust, replace the brake master cylinder reservoir cap diaphragm. The diaphragm may have allowed the moisture or particles to enter the hydraulic system.
5. Fill the brake master cylinder reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to *Adhesives, Fluids, Lubricants, and Sealers on page 5-133*.
6. Pressure bleed the hydraulic brake system. Begin the procedure with the pressure bleeder reservoir filled to the maximum-fill level with the correct brake fluid as indicated. Refer to *Hydraulic Brake System Bleeding (Manual) on page 5-211* or *Hydraulic Brake System Bleeding (Pressure) on page 5-212*.

Description and Operation

Brake System, Hydraulic, Assist, and Control Description and Operation

System Component Description



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The hydraulic brake system consists of the following:

Hydraulic Brake Master Cylinder Fluid Reservoir: Contains supply of brake fluid for the hydraulic brake system. Provides for brake fluid to be drawn back into and vented back from the master cylinder primary piston and secondary pistons. Also provides for brake fluid to be drawn into the motor driven pump and high pressure accumulator (HPA) areas of the brake modulator assembly, and vented back from various areas of the modulator assembly as needed. Provides markings for both the MIN and MAX parameters of the pressurized or operating range; and for the maximum depressurized or system OFF level.

Hydraulic Brake Master Cylinder: Converts mechanical input force into hydraulic output pressure. During normal operation, hydraulic output pressure is distributed from the primary piston of the master cylinder through hydraulic circuits to the pedal feel simulator within the brake modulator assembly. Hydraulic pressure for the wheel apply circuits is generated by a motor driven pump and stored by a high pressure accumulator (HPA) within the modulator assembly. This pressurized fluid is distributed through valves to the rear apply circuits and to the secondary pistons of the master cylinder which, in turn, distribute pressurized fluid to the front wheel apply circuits.

Hydraulic Brake Pipes and Flexible Brake Hoses: Carries brake fluid to and from hydraulic brake system components.

Hydraulic Brake Wheel Apply Components: Converts hydraulic input pressure into mechanical output force.

The brake assist system consists of the following:

Brake Pedal: Receives, multiplies and transfers brake system input force from the driver.

Brake Pedal Pushrod: Transfers multiplied input force received from the brake pedal to the brake booster.

Hydraulic Brake Modulator Assembly: Contains several high pressure sensors, valves, solenoids and filters as well as a motor driven pump, high pressure accumulator (HPA), high pressure filter, pedal feedback or pedal simulator and the electronic brake control module (EBCM). The assembly monitors various sensor, control module and driver inputs to determine and command the optimal amount of brake fluid pressure needed for a given situation. The modulator assembly then blends and delivers the pressurized fluid to the wheel apply circuits as appropriate for correct braking balance and performance.

System Operation

When the power button is placed in ON/RUN or a remote function actuation (RFA) commands remote START, the brake modulator assembly activates and pressurizes brake fluid for use at the wheel apply circuits as needed.

The brake modulator assembly incorporates a motor driven pump which is activated as required to draw brake fluid directly from the master cylinder reservoir, lowering the brake fluid level in the reservoir into the pressurized, or operating, range. The pump pressurizes and delivers the brake fluid to the high pressure accumulator (HPA) to store for use as necessary. Sensor data of HPA fluid pressure is used by the modulator to operate the pump to maintain the pressure of the brake fluid at the HPA within operating range. Working pressure of the HPA stored fluid is 140–180 bar (2030–2610 psi). Peak allowed pressure is 200 bar (2900 psi). Pressure relief is vented back to the master cylinder reservoir.

Brake system mechanical input force from the driver is multiplied by the brake pedal and transferred by the pedal pushrod to the hydraulic brake master cylinder. This mechanical force is converted into hydraulic pressure by the primary piston of the master cylinder. The pressurized brake fluid from the primary piston is delivered to the brake modulator assembly and is directed within the modulator to the brake pedal feel simulator.

To allow operation of the pedal feel simulator, the brake modulator assembly energizes and then closes the normally open (NO) valve to direct brake fluid only to the pedal feel simulator. The brake modulator also energizes and opens a normally closed (NC) valve to allow brake fluid to escape from the backside of the brake pedal feel simulator to the master cylinder reservoir, allowing the simulator piston to move. The pedal feel simulator incorporates a spring which causes increasing brake pedal effort and feedback through the master cylinder, providing brake pedal feel to the driver.

The brake modulator assembly uses sensor data of the brake pedal and pushrod travel and the master cylinder input fluid pressure to determine the amount of braking performance requested by the driver.

Based on the amount of braking action requested by the driver and sensor data inputs of fluid pressure throughout the brake modulator assembly passageways, the modulator uses a boost valve to continuously provide the optimal fluid pressure for use by the wheel apply circuits. The modulator assembly uses the boost valve to both build and relieve pressure within the wheel apply circuits. The boost valve meters the flow of pressurized brake fluid from the HPA to build pressure and relieves pressure as needed by venting fluid through the energized, and open, NC valve to the master cylinder reservoir. The brake modulator assembly also controls various valves in a way similar to a traditional brake modulator, to blend and modulate delivery of brake fluid to the wheel apply circuits, to achieve optimal balance and brake system output performance. The brake modulator delivers brake fluid to the wheel apply circuits as follows:

- Through isolation valves directly to the rear wheel apply circuits
- Through isolation valves directly to the secondary pistons of the master cylinder
- The secondary pistons of the master cylinder then delivers pressurized brake fluid directly to the front wheel apply circuits

Pressurized brake fluid is delivered to the wheel apply hydraulic components through the brake pipes and flexible hoses. The wheel apply components then convert the hydraulic pressure back into mechanical force which presses the brake linings against rotating brake system components to slow the vehicle through friction braking.

When the power button is placed in the OFF position and the brake pedal is not applied, the system will deactivate and depressurize. As the system begins to depressurize, brake fluid will discharge from the HPA and vent back into the master cylinder reservoir. This will cause the brake fluid level in the master cylinder reservoir to rise to the depressurized or system OFF range. The system may take up to 3 minutes to fully depressurize.

If the brake pedal is applied before the system has fully depressurized, the brake modulator will maintain the pressure available at the moment of the brake apply until the brake pedal is released. This will increase the amount of time required for the system to depressurize.

Regenerative Braking Function: During a regenerative braking event, the powertrain is used to create drag or torque braking through the drive axle, against the forward motion of the vehicle, while providing a charging function for the batteries.

The brake modulator assembly and the powertrain system controllers are in constant communication with each other. Each system is monitoring various system, sensor data, and driver inputs. Working together, a determination is made as to when the most appropriate opportunity for regenerative braking will occur. The brake modulator will request from the powertrain controllers the amount of torque braking that is available from the powertrain to be delivered through the drive axle. If the powertrain controllers in conjunction with the brake modulator have determined to perform a regenerative braking event, the brake modulator will request a specific amount of regenerative or torque braking to be provided from the powertrain.

Simultaneously, the brake modulator continuously evaluates and provides the correct blend of friction braking from the non-drive axle, and provides the correct blend of regenerative or torque braking and friction braking from the drive axle to provide the most efficient amount of regenerative braking and charging for the needs of the powertrain. All the while, providing optimal braking balance and providing the correct blend and amount of overall vehicle braking action requested by the driver through a brake pedal apply.

Deactivated System: If the brake modulator assembly is powered down either by placing the power button in the OFF position and not applying the brake pedal, or through a system power source failure or if the modulator detects certain critical faults, the system will operate as follows:

Brake system mechanical input force from the driver is multiplied by the brake pedal and transferred by the brake pedal pushrod to the hydraulic brake master cylinder. This mechanical force is converted into hydraulic pressure by the primary piston of the master cylinder.

The pressurized brake fluid from the primary piston is delivered to the brake modulator assembly and is directed within the brake modulator to the wheel apply passageways, rather than to the pedal simulator.

Since the modulator is not energizing the normally open (NO) valve to cause it to close and direct pressurized fluid only to the pedal simulator, the NO valve is open and directing fluid to both the pedal simulator and the wheel apply circuit passageways. To prevent any loss of pressure through the pedal simulator, or through the boost valve, the normally closed (NC) valve is closed since it is not energized by the modulator. Since the NC valve is closed, no fluid can escape from the backside of the simulator, thus preventing any movement of the piston within the pedal simulator and any subsequent loss of pressure. The same is true with the boost valve, since the NC valve is closed, no fluid can escape from the pressure relief side of the boost valve, thus preventing loss of pressure. The pressurized fluid is now delivered through the wheel apply circuit passageways within the modulator as follows:

- Through de-energized, open isolation valves directly to the rear wheel apply circuits
- Through de-energized, open isolation valves directly to the secondary pistons of the master cylinder
- The secondary pistons of the master cylinder then deliver pressurized brake fluid directly to the front wheel apply circuits

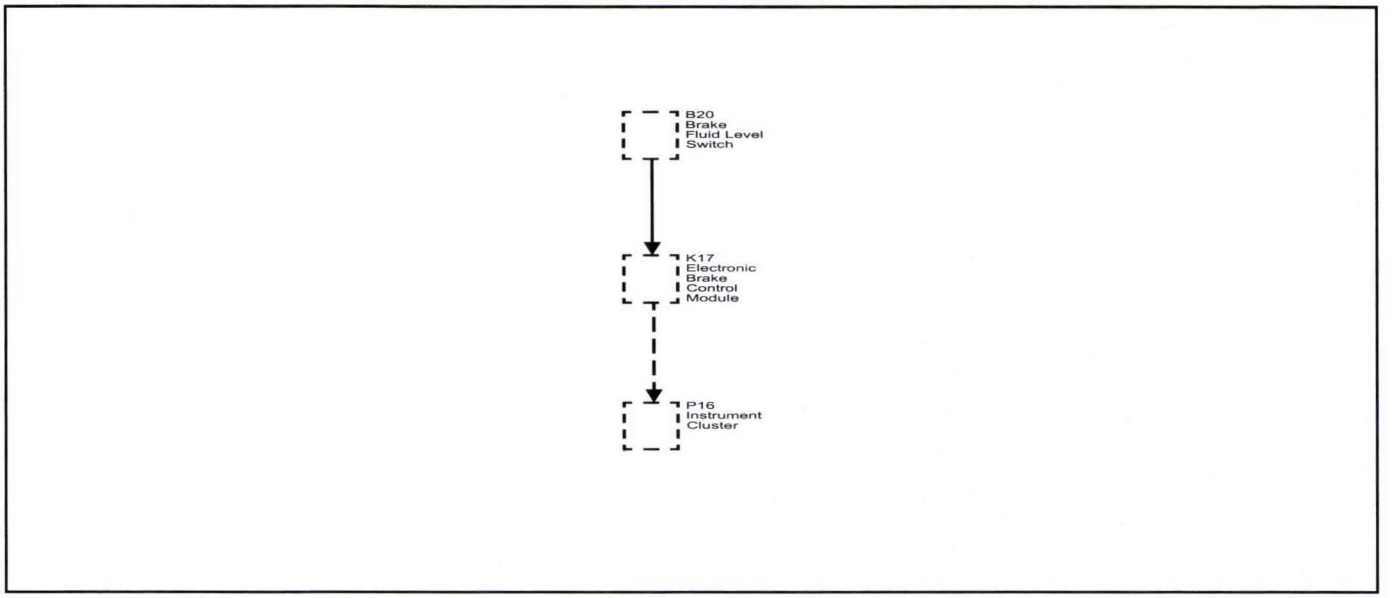
If a hydraulic failure occurs in the boost circuit of the modulator during further pedal apply, the system will operate as follows:

The mechanical input force is applied further as the primary piston of the master cylinder directly contacts the secondary pistons, which then convert the mechanical force into hydraulic pressure. The pressurized brake fluid from the secondary pistons is delivered directly to the front wheel apply circuits.

Brake Warning System Description and Operation

Brake Warning Indicator

Brake Warning Block Diagram



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The instrument cluster turns the brake warning indicator ON when the following occurs:

- The instrument cluster performs the bulb check. The brake warning indicator illuminates for 5 seconds.
- When the EBCM detects a too low brake fluid level it sets a DTC and sends a serial data message to the instrument cluster, which will illuminate.

Electronic brake control module (EBCM) monitors the brake fluid level in the brake fluid reservoir. When the fluid within the brake fluid reservoir is below the MIN level, contacts within the brake fluid level switch closes causing the voltage within the signal circuit to drop. The electronic brake control module (EBCM) will detect the voltage drop and will send a serial data message to the instrument cluster commanding the brake warning indicator to illuminate.

Hydraulic Brake System Description and Operation

System Component Description

The hydraulic brake system consists of the following:

Hydraulic Brake Master Cylinder Fluid Reservoir: Contains supply of brake fluid for the hydraulic brake system.

Hydraulic Brake Master Cylinder: Converts mechanical input force into hydraulic output pressure. Hydraulic output pressure is distributed from the master cylinder through 2 hydraulic circuits, supplying diagonally-opposed wheel apply circuits.

Hydraulic Brake Pressure Balance Control System: Regulates brake fluid pressure delivered to hydraulic brake wheel circuits, in order to control the distribution of braking force.

Pressure balance control is achieved through dynamic rear proportioning (DRP), which is a function of the ABS modulator.

Hydraulic Brake Pipes and Flexible Brake Hoses: Carries brake fluid to and from hydraulic brake system components.

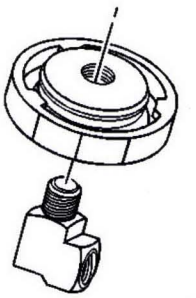
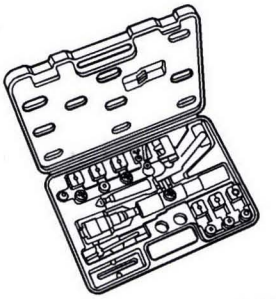
Hydraulic Brake Wheel Apply Components: Converts hydraulic input pressure into mechanical output force.

System Operation

Mechanical force is converted into hydraulic pressure by the master cylinder, regulated to meet braking system demands by the pressure balance control system, and delivered to the hydraulic brake wheel circuits by the pipes and flexible hoses. The wheel apply components then convert the hydraulic pressure back into mechanical force which presses linings against rotating brake system components.

Special Tools and Equipment

Illustration	Tool Number/ Description
2076273	CH 29532-A J 29532-A Pressure Brake Bleeder

Illustration	Tool Number/ Description
 741224	CH 44894-A J 44894-A Brake Pressure Bleeder Adapter
 900934	CH 45405 J 45405 Brake Pipe Flaring Kit

Park Brake

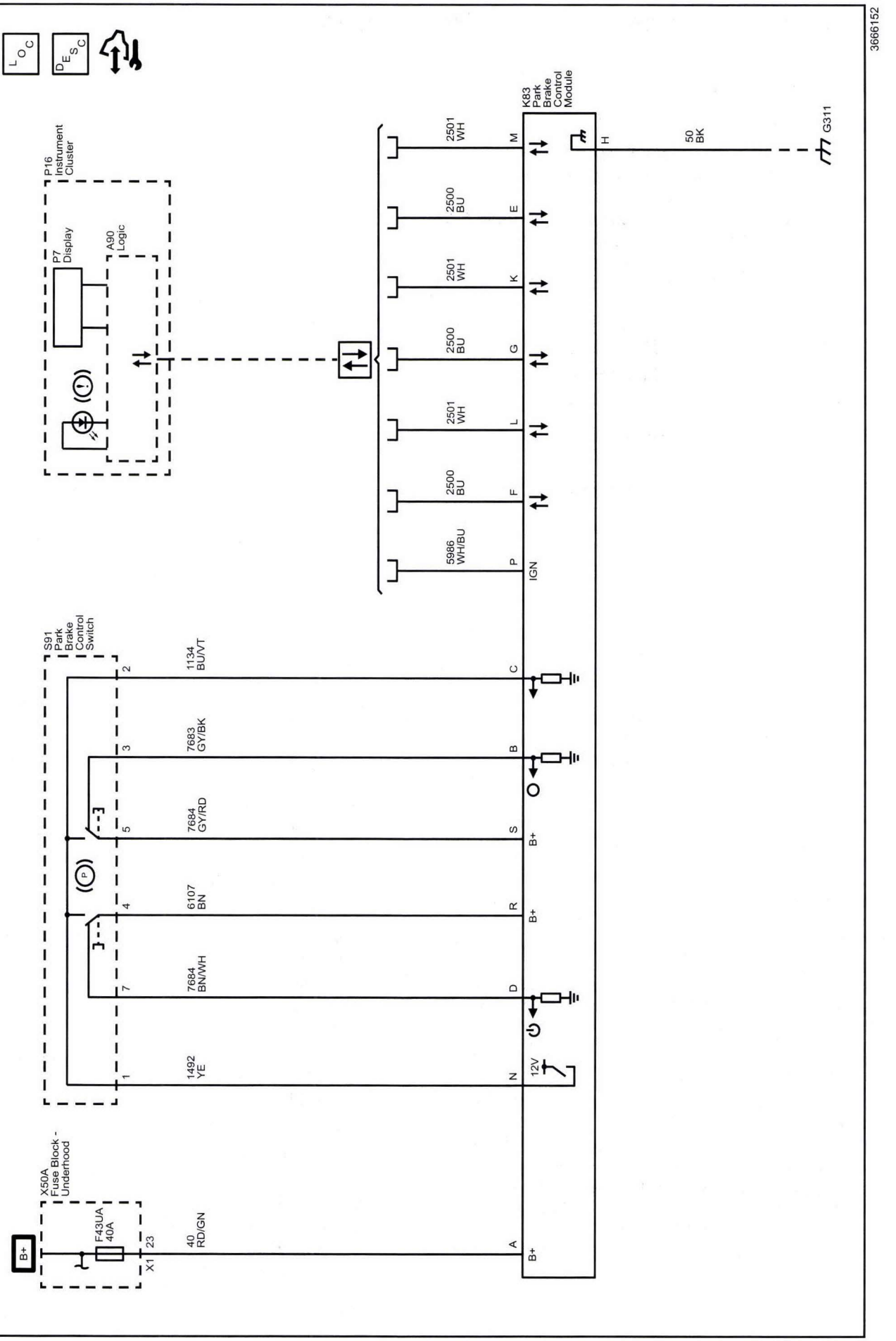
Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Electronic Parking Brake Control Module Bracket Nut	10 N•m	89 lb in
Park Brake Backing Plate Bolt	5 N•m	44 lb in
Parking Brake Cable Bracket Bolt	22 N•m	16 lb ft
Parking Brake Rear Cable Nut	6 N•m	53 lb in

Schematic and Routing Diagrams

Park Brake System Schematics (Park Brake System)



Diagnostic Information and Procedures

DTC C028A, C028B, or C028F

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provide an overview of each diagnostic category.

DTC Descriptors

DTC C028A: Park Brake Motor Circuit
DTC C028B: Park Brake Motor Position Circuit
DTC C028F: Park Brake Solenoid Actuator Circuit

For symptom byte information, refer to *Symptom Byte List on page 6-117*

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Park Brake Motor Circuit	C028A 02	C028A 04 C028A 05	C028A 01 C028A 05	C028A 08 C028A 28
Park Brake Motor Position Circuit	—	—	—	—
Park Brake Solenoid Actuator Circuit	C028F 02	—	C028F 01	C028F 08

Circuit/System Description

The parking brake control module has an internal motor, apply actuator, release actuator, and temperature sensor. The parking brake control module also contains the logic for applying and releasing the parking brake when commanded by the park brake control switch. When the parking brake control module receives a signal from the switch, the internal circuit board temperature is checked to verify it is within operating range before the control module performs the requested operation.

The parking brake control module will diagnose the internal park brake motor circuit to verify it is functioning properly. The park brake motor circuit is used to command motor operation, apply and release tension on the parking brake cable, which will apply and release the parking brake. The park brake will self diagnose the internal park brake motor circuit. This circuit is used to drive the motor, which pulls on the park brake cable, ultimately applying and releasing the park brake.

The parking brake control module contains an internal park brake motor position sensor which monitors the park brake motor position. The parking brake control module contains an internal park brake solenoid actuator, and performs diagnostics on the solenoid actuator circuitry to verify it is functioning properly.

Conditions for Running the DTC

- Vehicle in Service Mode or Vehicle ON.
- Battery voltage is between 9-16 V

Conditions for Setting the DTC

DTC C028A

The parking brake control module detects an internal motor malfunction.

DTC C028B

The parking brake control module detects an internal motor position sensor signal malfunction.

DTC C028F

The parking brake control module detects an internal park brake solenoid malfunction.

Action Taken When the DTC Sets

DTC C028A

- The parking brake is disabled.
- A message and/or a warning indicator may be displayed.

DTC C028B

- The parking brake is disabled, one release allowed.
- A message and/or a warning indicator may be displayed.

  OR

- The parking brake functionality is degraded.
- A message and/or a warning indicator may be displayed.

DTC C028F

- The parking brake is disabled, one release allowed.
- A message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The parking brake control module will clear the DTC after 40 consecutive ignition on/off cycles with at least one test pass in each ignition cycle and no test fail result.
- The condition for the DTC is no longer present.

Reference Information

Schematic Reference

Park Brake System Schematics on page 5-221

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Electronic Parking Brake Control Module Description on page 5-268

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC C028A, C028B, or C028F is not set.

⇒ **If any of the DTCs are set**

2.1. Program the K83 Parking Brake Control Module. Refer to *Electronic Parking Brake Control Module Programming and Setup on page 6-9*.

2.2. Vehicle in Service Mode. Apply and release the park brake.

2.3. Verify the DTC is not set.

⇒ If the DTC is set, replace the K83 Parking Brake Control Module.

⇓ If the DTC is not set

2.4. All OK.

⇓ **If none of the DTC are set**

3. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for parking brake control module replacement, programming and setup.

DTC C027D

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provide an overview of each diagnostic category.

DTC Descriptors

DTC C027D 64: Park Brake Slip Detected

Circuit/System Description

The parking brake control module has an internal motor, apply actuator, release actuator, and temperature sensor. The parking brake control module also contains the logic for applying and releasing the park brake when commanded by the park brake control switch. When the parking brake control module receives a signal from the switch, the internal circuit board temperature is checked to verify it is within operating range before the parking brake control module performs the requested operation. The parking brake control module checks for rear wheel speeds after applying the parking brake to check for mechanical faults.

Conditions for Running the DTC

Vehicle in Service Mode or Vehicle ON.

Conditions for Setting the DTC

The parking brake control module has detected wheel speed on the rear wheels with the parking brake applied.

Action Taken When the DTC Sets

A message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The parking brake control module will clear the DTC after 100 consecutive ignition on/off cycles with at least one test pass in each ignition cycle and no test fail result.
- Adjust or replace the park brake pads.

Reference Information

Schematic Reference

Park Brake System Schematics on page 5-221

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Electronic Parking Brake Control Module Description on page 5-268

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify no additional DTCs are set in other control modules.

⇒ **If additional DTCs are set**

Refer to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92*

⇓ **If no additional DTCs are set**

3. Verify that DTC C027D is not set.

⇒ **If the DTC is set**

3.1. Verify the park brake cable is connected properly. Refer to *Park Brake System Diagnosis on page 5-245*

3.2. Check park brake pads for excessive wear. Refer to *Disc Brake System Diagnosis on page 5-148*

3.3. Program the K83 Parking Brake Control Module. Refer to *Electronic Parking Brake Control Module Programming and Setup on page 6-9*.

3.4. Vehicle in Service Mode. Apply and release the park brake.

3.5. Verify the DTC is not set.

⇒ If the DTC is set, replace the K83 Parking Brake Control Module.

⇓ If the DTC is not set

3.6. All OK.

⇓ **If the DTC is not set**

4. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for parking brake control module replacement, programming and setup.

DTC C028E

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provide an overview of each diagnostic category.

DTC Descriptors

DTC C028E 05: Park Brake Solenoid Actuator Current Sensor Circuit Short to Battery or Open Circuit
DTC C028E 08: Park Brake Solenoid Actuator Current Sensor Circuit Performance – Signal Invalid

Circuit/System Description

The parking brake control module has an internal motor, apply actuator, release actuator, and temperature sensor. The parking brake control module also contains the logic for applying and releasing the parking brake when commanded by the park brake control switch. When the parking brake control module receives a signal from the switch, the internal circuit board temperature is checked to verify it is within operating range before the control module performs the requested operation.

The parking brake control module will diagnose the internal park brake motor circuit to verify it is functioning properly. The park brake motor circuit is used to command motor operation, apply and release tension on the parking brake cable, which will apply and release the parking brake. The park brake will self diagnose the internal park brake motor circuit. This circuit is used to drive the motor, which pulls on the park brake cable, ultimately applying and releasing the park brake.

The parking brake control module contains an internal park brake motor position sensor which monitors the park brake motor position. The parking brake control module contains an internal park brake solenoid actuator, and performs diagnostics on the solenoid actuator circuitry to verify it is functioning properly.

Conditions for Running the DTC

- Vehicle in Service Mode or Vehicle ON.
- Battery voltage is between 9-16 V

Conditions for Setting the DTC

The parking brake control module detects an internal park brake current sensor malfunction.

Action Taken When the DTC Sets

- The parking brake will apply very slowly to avoid wheel lock up.
- A message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The parking brake control module will clear the DTC after 40 consecutive ignition on/off cycles with at least one test pass in each ignition cycle and no test fail result.
- The condition for the DTC is no longer present.

Reference Information

Schematic Reference

Park Brake System Schematics on page 5-221

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Electronic Parking Brake Control Module Description on page 5-268

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify no additional DTCs are set in other control modules.

⇒ **If additional DTCs are set**

Refer to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92*.

⇓ **If no additional DTCs are set**

3. Verify DTC C028E is not set.

⇒ **If the DTC is set**

Refer to Circuit/System Testing.

⇓ **If the DTC is not set**

4. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness at the K83 Parking Brake Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal H and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open high/resistance in the circuit.

⇒ If less than 2 Ω, repair open high/resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify that a test lamp illuminates between the B+ circuit terminal A and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

4.1. Vehicle OFF.

4.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open high/resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

4.1. Vehicle OFF.

4.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ **If the test lamp illuminates**

5. Connect the harness connector at the K83 Parking Brake Control Module.
6. Verify the park brake cable is connected properly. Refer to *Park Brake System Diagnosis on page 5-245*

⇒ **If park brake cable is not connected properly**

Repair as necessary.

⇓ **If park brake cable is connected properly**

7. Vehicle in Service Mode. Apply and release the park brake.
8. Verify DTC C028E is not set.

⇒ **If the DTC set**

Replace the K83 Parking Brake Control Module.

⇓ **If the DTC is not set**

9. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for parking brake control module replacement, programming and setup.

DTC C0293

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provide an overview of each diagnostic category.

DTC Descriptors

DTC C0293 00: Park Brake Switch Circuit Malfunction
DTC C0293 01: Park Brake Switch Circuit Short to Battery
DTC C0293 02: Park Brake Switch Circuit Short to Ground
DTC C0293 04: Park Brake Switch Circuit Open
DTC C0293 08: Park Brake Switch Circuit Performance – Signal Invalid

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Park Brake Switch Supply Voltage Terminal N	C0298 08	C0298 08	—	C0293 08, C0298 08
Park Brake Apply Switch Voltage Reference Terminal D	C0293 02	C0293 04	C0293 01	C0293 08, C0298 08
Park Brake Release Switch Voltage Reference Terminal B	C0298 06	C0298 04	C0298 01	C0293 08, C0298 08
Park Brake Switch Signal Terminal C	C0298 08	C0298 08	—	C0293 08, C0298 08
Park Brake Apply Switch Signal Terminal R	C0293 02	C0293 04	C0293 01	C0293 08, C0298 08
Park Brake Release Switch Signal Terminal S	C0298 02	C0298 04	C0298 01	C0293 08, C0298 08

Circuit/System Description

The parking brake control module has an internal motor, apply actuator, release actuator, and temperature sensor. The parking brake control module also contains the logic for applying and releasing the parking brake when commanded by the park brake control switch. The parking brake control module will perform diagnostics on the park brake control switch and its wiring harness to verify it is functioning properly. When the parking brake control module receives a signal from the switch, the internal circuit board temperature is checked to verify it is within operating range before the control module performs the requested operation.

The park brake control switch diagnostic checks for failure conditions in the park brake control switch and associated wiring into the parking brake control module.

Conditions for Running the DTC

Vehicle in Service Mode or Vehicle ON.

Conditions for Setting the DTC

DTC C0293 00

The parking brake control module detects an internal malfunction.

DTC C0293 01

The parking brake control module detects a short to battery..

DTC C0293 02

The parking brake control module detects a short to ground.

DTC C0293 04

The parking brake control module detects an open circuit.

DTC C0293 08

The parking brake control module detects the apply or release button was activated for more than 90 seconds.

Action Taken When the DTC Sets

- The parking brake is disabled.
- A message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The parking brake control module will clear the DTC after 40 consecutive ignition on/off cycles with at least one test pass in each ignition cycle and no test fail result.
- The condition for the DTC is no longer present.
- The park brake control switch button is INACTIVE using the scan tool without the switch being activated.

Reference Information

Schematic Reference

Park Brake System Schematics on page 5-221

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Electronic Parking Brake Control Module Description on page 5-268

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U0128 is not set.

⇒ **If the DTC is set**

Please Refer to *DTC U0100-U02FF on page 11-81*

⇓ **If the DTC is not set**

3. Verify the scan tool Park Brake Status parameter changes between Released and Apply while pressing and releasing the S91 Park Brake Control Switch.

⇒ **If the parameter does not change**

Refer to Circuit/System Test.

⇓ **If the parameter changes**

4. All OK.

Circuit/System Test

1. Vehicle OFF, disconnect the harness connector at the K83 Parking Brake Control Module.
2. Test for less than 1 V between the circuit terminals listed below and ground:
   - Terminal B
   - Terminal C
   - Terminal D
   - Terminal N
   - Terminal R
   - Terminal S

⇒ **If 1 V or greater**

Repair the short to voltage on the circuit.

⇓ **If less than 1 V**

3. Vehicle OFF.
4. Test for infinite resistance between the circuit terminals listed below and ground:
   - Terminal B
   - Terminal C
   - Terminal D
   - Terminal N
   - Terminal R
   - Terminal S

⇒ **If less than infinite resistance**

Repair the short to ground on the circuit.

⇓ **If infinite resistance**

5. Test for less than 5 Ω between the circuit terminal D and the circuit terminal R.

⇒ **If 5 Ω or greater**

5.1. Vehicle OFF, disconnect the harness connector at the S91 Park Brake Control Switch.

5.2. Test for less than 2 Ω in the circuits end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the S91 Park Brake Control Switch.

⇓ **If less than 5 Ω**

6. Test for less than 5 Ω between the circuit terminal B and the circuit terminal S.

⇒ **If 5 Ω or greater**

6.1. Vehicle OFF, disconnect the harness connector at the S91 Park Brake Control Switch.

6.2. Test for less than 2 Ω in the signal circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the S91 Park Brake Control Switch.

⇓ **If less than 5 Ω**

7. Test for less than 5 Ω between the circuit terminal C and the circuit terminal N.

⇒ **If 5 Ω or greater**

7.1. Vehicle OFF, disconnect the harness connector at the S91 Park Brake Control Switch.

7.2. Test for less than 2 Ω in the circuits end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the S91 Park Brake Control Switch.

⇓ **If less than 5 Ω**

8. Test for less than 5 Ω between the circuit terminal N and the circuit terminal R while closing the switch.

⇒ **If 5 Ω or greater**

Replace the S91 Park Brake Control Switch.

⇓ **If less than 5 Ω**

9. Test for less than 5 Ω between the circuit terminal N and the circuit terminal S while closing the switch.

⇒ **If 5 Ω or greater**

Replace the S91 Park Brake Control Switch.

⇓ **If less than 5 Ω**

10. Replace the K83 Parking Brake Control Module.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Parking Brake Actuator Switch Replacement on page 5-265*
- *Control Module References on page 6-3* for control module replacement, programming and setup.

DTC C0298

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provide an overview of each diagnostic category.

DTC Descriptors

DTC C0298 00: Park Brake Unlatch Switch Circuit Malfunction
DTC C0298 01: Park Brake Unlatch Switch Circuit Short to Battery
DTC C0298 02: Park Brake Unlatch Switch Circuit Short to Ground
DTC C0298 04: Park Brake Unlatch Switch Circuit Open
DTC C0298 08: Park Brake Unlatch Switch Circuit Performance – Signal Invalid

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Park Brake Switch Supply Voltage Terminal N	C0298 08	C0298 08	—	C0293 08, C0298 08
Park Brake Apply Switch Voltage Reference Terminal D	C0293 02	C0293 04	C0293 01	C0293 08, C0298 08
Park Brake Release Switch Voltage Reference Terminal B	C0298 06	C0298 04	C0298 01	C0293 08, C0298 08
Park Brake Switch Signal Terminal C	C0298 08	C0298 08	—	C0293 08, C0298 08
Park Brake Apply Switch Signal Terminal R	C0293 02	C0293 04	C0293 01	C0293 08, C0298 08
Park Brake Release Switch Signal Terminal S	C0298 02	C0298 04	C0298 01	C0293 08, C0298 08

Circuit/System Description

The parking brake control module has an internal motor, apply actuator, release actuator, and temperature sensor. The parking brake control module also contains the logic for applying and releasing the parking brake when commanded by the park brake control switch. When the parking brake control module receives a signal from the switch, the internal circuit board temperature is checked to verify it is within operating range before the control module performs the requested operation.

Conditions for Running the DTC

Vehicle in Service Mode or Vehicle ON.

Conditions for Setting the DTC

DTC C0298 00

The parking brake control module detects an internal malfunction.

DTC C0298 01

The parking brake control module detects a short to battery.

DTC C0298 02

The parking brake control module detects a short to ground.

DTC C0298 04

The parking brake control module detects an open circuit.

DTC C0298 08

The parking brake control module detects the apply or release button was activated for more than 90 seconds.

Action Taken When the DTC Sets

A message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The parking brake control module will clear the DTC after 40 consecutive ignition on/off cycles with at least one test pass in each ignition cycle and no test fail result.
- The condition for the DTC is no longer present.
- The park brake control switch button is INACTIVE using the scan tool without the switch being activated.

Diagnostic Aids

Check if the park brake control switch is stuck in the apply or release position which may cause the DTC to set.

Reference Information

Schematic Reference

Park Brake System Schematics on page 5-221

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Electronic Parking Brake Control Module Description on page 5-268

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U0128 is not set.

⇒ **If the DTC is set**

Please Refer to *DTC U0100-U02FF on page 11-81*

⇓ **If the DTC is not set**

3. Verify the scan tool Park Brake Status parameter changes between Released and Apply while pressing and releasing the S91 Park Brake Control Switch.

⇒ **If the parameter does not change**

Refer to Circuit/System Test.

⇓ **If the parameter changes**

4. All OK.

Circuit/System Test

1. Vehicle OFF, disconnect the harness connector at the K83 Parking Brake Control Module.
2. Test for less than 1 V between the circuit terminals listed below and ground:
   - Terminal B
   - Terminal C
   - Terminal D
   - Terminal N
   - Terminal R
   - Terminal S

⇒ **If 1 V or greater**

Repair the short to voltage on the circuit.

⇓ **If less than 1 V**

3. Vehicle OFF.
4. Test for infinite resistance between the circuit terminals listed below and ground:
   - Terminal B
   - Terminal C
   - Terminal D
   - Terminal N
   - Terminal R
   - Terminal S

⇒ **If less than infinite resistance**

Repair the short to ground on the circuit.

⇓ **If infinite resistance**

5. Test for less than 5 Ω between the circuit terminal D and the circuit terminal R.

⇒ **If 5 Ω or greater**

5.1. Vehicle OFF, disconnect the harness connector at the S91 Park Brake Control Switch.

5.2. Test for less than 2 Ω in the circuits end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the S91 Park Brake Control Switch.

⇓ **If less than 5 Ω**

6. Test for less than 5 Ω between the circuit terminal B and the circuit terminal S.

⇒ **If 5 Ω or greater**

6.1. Vehicle OFF, disconnect the harness connector at the S91 Park Brake Control Switch.

6.2. Test for less than 2 Ω in the circuits end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the S91 Park Brake Control Switch.

⇓ **If less than 5 Ω**

7. Test for less than 5 Ω between the circuit terminal C and the circuit terminal N.

⇒ **If 5 Ω or greater**

7.1. Vehicle OFF, disconnect the harness connector at the S91 Park Brake Control Switch.

7.2. Test for less than 2 Ω in the circuits end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, test or replace the S91 Park Brake Control Switch.

⇓ **If less than 5 Ω**

8. Test for less than 5 Ω between the circuit terminal N and the circuit terminal R while closing the switch.

⇒ **If 5 Ω or greater**

Test or replace the S91 Park Brake Control Switch.

⇓ **If less than 5 Ω**

9. Test for less than 5 Ω between the circuit terminal N and the circuit terminal S while closing the switch.

⇒ **If 5 Ω or greater**

Test or replace the S91 Park Brake Control Switch.

⇓ **If less than 5 Ω**

10. Replace the K83 Parking Brake Control Module.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

- *Parking Brake Actuator Switch Replacement on page 5-265*
- *Control Module References on page 6-3* for control module replacement, programming and setup.

DTC C0558

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provide an overview of each diagnostic category.

DTC Descriptors

DTC C0558 55: Calibration Data Too Few Transitions

DTC C0558 5A: Calibration Data Not Plausible

Circuit/System Description

The parking brake control module has an internal motor, apply actuator, release actuator, and temperature sensor. The parking brake control module also contains the logic for applying and releasing the parking brake when commanded by the park brake control switch. When the parking brake control module receives a signal from the switch, the internal circuit board temperature is checked to verify it is within operating range before the control module performs the requested operation.

Conditions for Running the DTC

Vehicle in Service Mode or Vehicle ON.

Conditions for Setting the DTC

C0558 55

The parking brake control module detects a calibration malfunction.

C0558 5A

The parking brake control module detects mechanical problems with the parking brake system.

Action Taken When the DTC Sets

C0558 55

- The parking brake is disabled, switch command will not be accepted.
- A message and/or a warning indicator may be displayed.

C0558 5A

- The parking brake is disabled, one release allowed.
- A message and/or a warning indicator may be displayed.

  OR
- The parking brake functionality is degraded.
- A message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The parking brake control module will clear the DTC after 40 consecutive ignition on/off cycles with at least one test pass in each ignition cycle and no test fail result.
- Calibrate the parking brake control module after mechanical repairs are made.

Diagnostic Aids

- Verify the parking brake control module software and calibrations are the newest available versions.
- Verify the parking brake cable and related hardware is not broken, seized or pinched.

Reference Information

Schematic Reference

Park Brake System Schematics on page 5-221

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Electronic Parking Brake Control Module Description on page 5-268

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC C0558 55 is not set.

⇒ **If DTC C0558 55 is set**

2.1. Program the K83 Parking Brake Control Module. Refer to *Electronic Parking Brake Control Module Programming and Setup on page 6-9*

2.2. Vehicle in Service Mode. Apply and release the park brake.

2.3. Verify the DTC is not set.

⇒ If the DTC is set, replace the K83 Parking Brake Control Module.

⇓ If the DTC is not set

2.4. All OK.

⇓ **If DTC C0558 55 is not set**

3. Verify the scan tool Park Brake Cable Position parameter is less than 1251 counts.

⇒ **If 1251 counts or greater**

3.1. Verify the park brake cable is connected properly. Refer to *Park Brake System Diagnosis on page 5-245*

3.2. Check park brake pads for excessive wear. Refer to *Disc Brake System Diagnosis on page 5-148*

⇓ **If less than 1251 counts**

4. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for parking brake control module replacement, programming and setup.

DTC C0561

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provide an overview of each diagnostic category.

DTC Descriptors

DTC C0561 71: System Disabled Information Stored Invalid Data

Circuit/System Description

The parking brake control module has an internal motor, apply actuator, release actuator, and temperature sensor. The parking brake control module also contains the logic for applying and releasing the parking brake when commanded by the park brake control switch. When the parking brake control module receives a signal from the switch, the internal circuit board temperature is checked to verify it is within operating range before the control module performs the requested operation. The parking brake module will verify it has a valid signal from other modules before it performs the requested operation.

Conditions for Running the DTC

- Vehicle in Service Mode or Vehicle ON.
- Battery voltage is between 9-16 V.

Conditions for Setting the DTC

The parking brake control module receives an invalid serial data message or does not receive a serial data message from another module.

Action Taken When the DTC Sets

- A message and/or a warning indicator may be displayed.
- The parking brake functionality is degraded.

Conditions for Clearing the DTC

- The parking brake control module will clear the DTC after 40 consecutive ignition on/off cycles with at least one test pass in each ignition cycle and no test fail result.
- The parking brake control module receives valid signals from other modules.

Reference Information

Schematic Reference

Park Brake System Schematics on page 5-221

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Electronic Parking Brake Control Module Description on page 5-268

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify no additional DTCs are set in other control modules.

⇒ **If additional DTCs are set**

Refer to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92*

⇓ **If no additional DTCs are set**

3. Verify the scan tool Park Brake Control Module Invalid Signal Identification parameters are all Valid.

⇒ **If any parameter is Invalid**

Refer to the appropriate subsection in which the failure occurred. Refer to *Symptoms - Vehicle on page 6-122*

⇓ **If all parameters are Valid**

4. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

DTC C056D

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provide an overview of each diagnostic category.

DTC Descriptors

DTC C056D 00: Electronic Control Unit Hardware Malfunction
DTC C056D 34: Electronic Control Unit Hardware RAM Malfunction
DTC C056D 35: Electronic Control Unit Hardware ROM Malfunction
DTC C056D 36: Electronic Control Unit Hardware EEPROM Performance/Malfunction
DTC C056D 37: Electronic Control Unit Hardware Software Malfunction
DTC C056D 38: Electronic Control Unit Hardware Supervision Software Malfunction
DTC C056D 39: Electronic Control Unit Hardware Internal Malfunction
DTC C056D 3B: Electronic Control Unit Hardware Internal Self – Test Malfunction
DTC C056D 3C: Electronic Control Unit Hardware Internal Communication Malfunction

Circuit/System Description

The parking brake control module has an internal motor, apply actuator, release actuator, and temperature sensor. The parking brake control module also contains the logic for applying and releasing the parking brake when commanded by the park brake control switch. When the parking brake control module receives a signal from the switch, the internal circuit board temperature is checked to verify it is within operating range before the control module performs the requested operation. The parking brake module will perform diagnostics on the modules internal hardware to verify it is functioning properly

Conditions for Running the DTC

Vehicle in Service Mode or Vehicle ON.

Conditions for Setting the DTC

The parking brake control module detects an internal hardware malfunction.

Action Taken When the DTC Sets

DTC C056D 00, C056D 34, C056D 35, C056D 36, C056D 37, C056D 38, C056D 3B, or C056D 3C

- The parking brake is disabled.
- A message and/or a warning indicator may be displayed.

DTC C056D 39

- The parking brake is disabled, one release allowed.
- A message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The parking brake control module will clear the DTC after 40 consecutive ignition on/off cycles with at least one test pass in each ignition cycle and no test fail result.
- The condition for the DTC is no longer present.
- The latest software and calibrations are programmed into the parking brake control module.

Reference Information

Schematic Reference

Park Brake System Schematics on page 5-221

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Electronic Parking Brake Control Module Description on page 5-268

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC C056D 36 is not set.

⇒ **If DTC C056D 36 is set**

2.1. Program the K83 Parking Brake Control Module. Refer to *Electronic Parking Brake Control Module Programming and Setup on page 6-9*.

2.2. Vehicle in Service Mode.

2.3. Apply and release the park brake.

2.4. Verify the DTC is not set.

⇒ If the DTC is set, replace the K83 Parking Brake Control Module.

⇓ If the DTC is not set

2.5. All OK.

⇓ **If DTC C056D 36 is not set**

3. Perform the Parking Brake Motor Reset procedure with a scan tool for the Parking Brake Control Module.
4. Verify DTC C056D is not set.

⇒ **If DTC C056D is set**

Replace the K83 Parking Brake Control Module.

⇓ **If DTC C056D is not set**

5. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for parking brake control module replacement, programming and setup.

DTC C056E

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provide an overview of each diagnostic category.

DTC Descriptors

DTC C056E 41: Electronic Control Unit Software Not Programmed
DTC C056E 42: Electronic Control Unit Software Calibration Not Programmed
DTC C056E 47: Electronic Control Unit Software VIN Not Programmed
DTC C056E 5A: Electronic Control Unit Software Not Plausible
DTC C056E 71: Electronic Control Unit Software Invalid Data

Circuit/System Description

The parking brake control module has an internal motor, apply actuator, release actuator, and temperature sensor. The parking brake control module also contains the logic for applying and releasing the park brake when commanded by the park brake control switch. When the parking brake control module receives a signal from the switch, the internal circuit board temperature is checked to verify it is within operating range before the parking brake control module performs the requested operation.

Conditions for Running the DTC

Vehicle in Service Mode or Vehicle ON.

Conditions for Setting the DTC

The parking brake module has detected missing calibration data, calibration procedure not run or completed, missing VIN, or internal software malfunction.

Actions Taken When DTC Sets

C056E 41 or C056E 5A

- The parking brake is disabled.
- A message and/or a warning indicator may be displayed.

C056E 42

- The parking brake functionality is degraded or disabled.
- A message and/or a warning indicator may be displayed.

C056E 47 or C056E 71

The parking brake will function normally.

Conditions for Clearing the DTC

- The parking brake control module will clear the DTC after 40 consecutive ignition on/off cycles with at least one test pass in each ignition cycle and no test fail result.
- The condition for the DTC is no longer present.
- The latest software and calibrations are programmed into the parking brake control module.

Reference Information

Schematic Reference

Park Brake System Schematics on page 5-221

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Electronic Parking Brake Control Module Description on page 5-268

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC C056E is not set.

⇒ **If the DTC is set**

2.1. Program the K83 Parking Brake Control Module. Refer to *Electronic Parking Brake Control Module Programming and Setup on page 6-9*

2.2. Verify the DTC is not set.

⇒ If the DTC is set, replace the K83 Parking Brake Control Module.

⇓ If the DTC is not set

2.3. All OK.

⇓ **If the DTC is not set**

3. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for parking brake control module replacement, programming and setup.

DTC C0574

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provide an overview of each diagnostic category.

DTC Descriptors

DTC C0574 00: Printed Circuit Board Temperature Sensor Malfunction
DTC C0574 01: Printed Circuit Board Temperature Sensor Short to Battery
DTC C0574 02: Printed Circuit Board Temperature Sensor Short to Ground
DTC C0574 54: Printed Circuit Board Temperature Sensor High

Circuit/System Description

The parking brake control module has an internal motor, apply actuator, release actuator, and temperature sensor. The parking brake control module also contains the logic for applying and releasing the parking brake when commanded by the park brake control switch. When the parking brake control module receives a signal from the switch, the internal circuit board temperature is checked to verify it is within operating range before the control module performs the requested operation.

Conditions for Running the DTC

Vehicle in Service Mode or Vehicle ON.

Conditions for Setting the DTC

C0574 01 or C0574 02

The parking brake control module detects a short to battery or a short to ground.

C0574 00 or C0574 54

The parking brake control module has detected an internal temperature that is above the allowed value.

Action Taken When the DTC Sets

- A message and/or a warning indicator may be displayed.
- The park brake is disabled, one release allowed.

Conditions for Clearing the DTC

- The parking brake control module clears the history DTC when a current DTC is not detected in 40 ignition cycles.
- The parking brake control module is replaced or the internal temperature drops below the allowed temperature.

Diagnostic Aids

- Check for debris on the parking brake control module which may cause the module to overheat.
- Diagnose all other parking brake control module system related faults before performing this diagnostic. Other faults may cause the circuit board to overheat. Do not attempt to apply the park brake.

Reference Information

Schematic Reference

Park Brake System Schematics on page 5-221

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Electronic Parking Brake Control Module Description on page 5-268

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify no additional DTCs are set in other control modules.

⇒ **If additional DTCs are set**

Refer to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92*

⇓ **If no additional DTCs are set**

3. Verify that DTC C0574 01 or C0574 02 is not set.

⇒ **If DTC C0574 01 or C0574 02 is set**

3.1. Ignition OFF. Remove the parking brake control module fuse and reinstall. Vehicle in Service Mode.

3.2. Verify DTC C0574 01 or C0574 02 is not set.

⇒ If the DTC is set, replace the K83 Parking Brake Control Module.

⇓ If the DTC is not set

3.3. All OK.

⇓ **If DTC C0574 01 or C0574 02 is not set**

4. Allow the K83 Parking Brake Control Module to cool down for 15 minutes.
5. Verify the scan tool Calculated System Temperature parameter is less than 105° C.

⇒ **If 105° C or greater**

Replace the K83 Parking Brake Control Module.

⇓ **If less than 105° C**

6. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for parking brake control module replacement, programming and setup.

DTC C1280 or C1281

Diagnostic Instructions

- Perform the *Diagnostic System Check - Vehicle on page 6-91* prior to using this diagnostic procedure.
- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic Procedure Instructions on page 6-84* provides an overview of each diagnostic category.

DTC Descriptor

DTC C1280: Electric Park Brake Availability Status Message Counter Incorrect

DTC C1281: Electric Park Brake Availability Status Message Counter Incorrect

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	C1280, C1281, U1803	C1280, C1281, U1803	—	—
Ignition	C1280, C1281, U1803	C1280, C1281, U1803	—	—
Accessory Wakeup Serial Data	C1280, C1281, U1803	C1280, C1281, U1803	—	—
Low Speed GMLAN Serial Data	1	C1280, C1281, U1803	1	—
High Speed GMLAN Serial Data (+)	2	C1280, C1281, U1803, U0073	2	—
High Speed GMLAN Serial Data (-)	2	C1280, C1281, U1803, U0073	2	—
Powertrain High Speed GMLAN Serial Data (+)	C1280, C1281, U0074	C1280, C1281, U1803, U0074	C1280, C1281, U0074	—
Powertrain High Speed GMLAN Serial Data (-)	C1280, C1281, U0074	C1280, C1281, U1803, U0074	C1280, C1281, U0074	—
High Voltage Energy Management High Speed GMLAN Serial Data (+)	C1280, C1281, U007A	C1280, C1281, U1803, U007A	C1280, C1281, U007A	—
High Voltage Energy Management High Speed GMLAN Serial Data (-)	C1280, C1281, U007A	C1280, C1281, U1803, U007A	C1280, C1281, U007A	—
Ground	—	C1280, C1281, U1803	—	—

1. Scan Tool Does Not Communicate With Low Speed GMLAN Device
2. Scan Tool Does Not Communicate With High Speed GMLAN Device

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the data link connector (DLC), the scan tool can be used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTC). When the vehicle is on, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non communicating device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is between 9–16 V.

Conditions for Setting the DTC

A supervised periodic message from the parking brake control module has not been received or the hybrid/EV powertrain control module 2 has detected an incorrect message counter.

Action Taken When the DTC Sets

DTC C1280 and C1281 are type A DTCs.

Conditions for Clearing the DTC

- DTC C1280 and C1281 are type A DTCs.
- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of-communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
  - A device on the data communication circuit was disconnected while the communication circuit is awake.
  - Power to one or more devices was interrupted during diagnosis.
  - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
  - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
  - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use *Data Link References on page 11-232* to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- *Data Communication Schematics on page 11-6*
- *Control Module References on page 6-3*

Connector End View Reference

Component Connector End Views on page 11-455

Description and Operation

Data Link Communications Description and Operation on page 11-237

Electrical Information Reference

- *Circuit Testing on page 11-871*
- *Connector Repairs on page 11-895*
- *Testing for Intermittent Conditions and Poor Connections on page 11-877*
- *Wiring Repairs on page 11-883*

Scan Tool Reference

Control Module References on page 6-3 for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0073, U0074, U0077, U0078, U007A, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.

⇒ **If any of the DTCs are set**

Refer to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92*.

⇓ **If none of the DTCs are set**

3. Refer to Circuit/System Testing.

Circuit/System Testing

Note: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the harness connector at the K83 Parking Brake Control Module.
2. Test for less than 10 Ω between the ground circuit terminal H and ground.

⇒ **If 10 Ω or greater**

2.1. Vehicle OFF.

2.2. Test for less than 2 Ω in the ground circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, repair the open/high resistance in the ground connection.

⇓ **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal A and ground.

⇒ **If the test lamp does not illuminate and the circuit fuse is good**

4.1. Vehicle OFF.

4.2. Test for less than 2 Ω in the B+ circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

⇒ **If the test lamp does not illuminate and the circuit fuse is open**

4.1. Vehicle OFF.

4.2. Test for infinite resistance between the B+ circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇒ If infinite resistance, replace the K83 Parking Brake Control Module.

⇓ **If the test lamp illuminates**

5. Verify a test lamp illuminates between the ignition circuit terminal P and ground.

⇒ **If the test lamp does not illuminate**

5.1. Vehicle OFF, disconnect the harness connectors at the K9 Body Control Module.

5.2. Test for infinite resistance between the ignition circuit and ground.

⇒ If less than infinite resistance, repair the short to ground on the circuit.

⇓ If infinite resistance

5.3. Test for less than 2 Ω in the ignition circuit end to end.

⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.

⇒ If less than 2 Ω, replace the K9 Body Control Module.

⇓ **If the test lamp illuminates**

6. Vehicle OFF, all access doors closed, all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2.
7. Test for less than 2 Ω in each serial data circuits end to end between the K83 Parking Brake Control Module and the K114B Hybrid/EV Powertrain Control Module 2.

⇒ **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

⇓ **If less than 2 Ω**

8. Reconnect all of the harness connectors at the K83 Parking Brake Control Module and the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
9. Program the K83 Parking Brake Control Module. Refer to *Electronic Parking Brake Control Module Programming and Setup on page 6-9*
10. Vehicle in Service Mode. Apply and release the park brake.
11. Verify that DTC C1280 or C1281 is not set.

⇒ **If DTC C1280 or C1281 is set**

11.1. Replace the K83 Parking Brake Control Module.

11.2. Vehicle in Service Mode.

11.3. Verify that DTC C1280 or C1281 is not set.

⇒ If DTC C1280 or C1281 is set, replace the K114B Hybrid/EV Powertrain Control Module 2.

⇓ If DTC C1280 or C1281 is not set

11.4. All OK.

⇓ **If DTC C1280 or C1281 is not set**

12. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for parking brake control module or hybrid/EV powertrain control module 2 replacement, programming and setup.

Symptoms - Park Brake

Important: Review the system operation in order to familiarize yourself with the system functions.

Refer to *Electronic Parking Brake Control Module Description on page 5-268*.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the park brake system.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

Park Brake Will Not Hold or Release on page 5-245

Park Brake Will Not Hold or Release

Step	Action	Yes	No
1	Were you sent here from the Park Brake Symptom table?	Go to *Step 2*	Go to *Diagnostic Starting Point - Vehicle on page 6-90*
2	Inspect the park brake system for proper operation. Refer to *Park Brake System Diagnosis on page 5-245.* Did you find and correct a condition?	Go to *Step 5*	Go to *Step 3*
3	Inspect the disc brake system for proper operation. Refer to *Disc Brake System Diagnosis on page 5-148.* Did you find and correct a condition?	Go to *Step 5*	Go to *Step 4*
4	Inspect the hydraulic brake system for proper operation. Refer to *Brake Hydraulic and Assist System Diagnosis on page 5-153.* Did you find and correct a condition?	Go to *Step 5*	Go to *Diagnostic Starting Point - Vehicle on page 6-90*
5	Road test the vehicle in order to confirm proper operation. Refer to *Brake System Vehicle Road Test on page 5-161.* Is the condition still present?	Go to *Step 2*	System OK

Park Brake System Diagnosis

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the PARK brake system in order to determine if the PARK brake system is operating properly. You will be directed by the appropriate Symptom Table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Hydraulic Brake Symptom Table?	Go to *Step 3*	Go to *Step 2*
2	Were you sent here from a Park Brake Symptom Table?	Go to *Step 3*	Go to *Diagnostic Starting Point - Vehicle on page 6-90*
3	1. Raise and support the vehicle with the rear axle supported by jack stands. Refer to *Lifting and Jacking the Vehicle on page 1-27.* 2. With the park brake RELEASED, attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag. Do the rear brakes have a significant amount of drag?	Go to *Step 8*	Go to *Step 4*
4	1. Apply the park brake. 2. Attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag. Do the rear brakes have a significant amount of drag?	Go to *Step 17*	Go to *Step 5*
5	Visually check the park brake cable connections and the cables that are accessible on the UNDERSIDE of the vehicle for disconnections and/or damage. Were any or the park brake cables disconnected and/or damaged?	Go to *Step 6*	Go to *Step 7*
6	Reconnect or replace the park brake cables as necessary. Refer to the following procedures as necessary: • *Parking Brake Rear Cable Replacement on page 5-254* • *Parking Brake Rear Cable Replacement - Left Side on page 5-256* • *Parking Brake Rear Cable Replacement - Right Side on page 5-258* Did you complete the repair and/or replacement?	Go to *Step 17*	—
7	Check the adjustment of the park brake and adjust as necessary. Refer to *Parking Brake Adjustment on page 5-267.* Did you find and correct the condition?	Go to *Step 17*	Go to *Step 8*

Park Brake System Diagnosis (cont'd)

Step	Action	Yes	No
8	**Caution:** Do not depress the brake pedal with the brake rotors and/or the brake drums removed, or with the brake calipers repositioned away from the brake rotors, or damage to the brake system may result. 1. Remove the rear brake rotors. Refer to *Rear Brake Rotor Replacement on page 5-124*. 2. Inspect the park brake shoe hardware for looseness, damaged, broken or missing components. 3. Check the park brake actuators for a seized condition. Does the park brake hardware and/or the park brake actuators require replacement?	Go to *Step 9*	Go to *Step 10*
9	Replace park brake hardware components as necessary. Refer to *Parking Brake Shoe Replacement on page 5-249*. Did you complete the replacement?	Go to *Step 17*	—
10	With the aid of an assistant, apply and release the parking brake while observing the cables for free movement. Do the park brake cables move freely?	Go to *Step 11*	Go to *Step 13*
11	Check the adjustment of the park brake and adjust as necessary. Refer to *Parking Brake Adjustment on page 5-267*. Did you find and correct the condition?	Go to *Step 17*	Go to *Step 12*
12	1. Apply the park brake. 2. Attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag. 3. Release the park brake. 4. Rotate the rear wheels to check the rear brakes for a significant reduction of drag. Did the park brake apply and release properly?	Go to *Step 17*	Go to *Symptoms - Park Brake on page 5-244*
13	Disconnect the park brake cable connections that are accessible on the UNDERSIDE of the vehicle one at a time and check each cable for free movement. Do any of the park brake cables accessible on the underside of the vehicle require replacement?	Go to *Step 14*	Go to *Step 15*
14	Replace any of the park brake cables that do not have free movement (not releasing properly). Refer to the following procedures as necessary: • *Parking Brake Rear Cable Replacement on page 5-254* • *Parking Brake Rear Cable Replacement - Left Side on page 5-256* • *Parking Brake Rear Cable Replacement - Right Side on page 5-258* Did you complete the replacement?	Go to *Step 17*	—
15	Inspect the electronic parking brake control module for proper operation and replace as necessary. Refer to *Electronic Parking Brake Control Module Replacement on page 5-247*. Did you find and correct the condition?	Go to *Step 17*	Go to *Step 16*
16	1. Replace the component that is used to adjust the park brake system. Refer to *Electronic Parking Brake Control Module Replacement on page 5-247*. 2. Adjust the park brake. Refer to *Parking Brake Adjustment on page 5-267*. Did you complete the replacement and adjustment?	Go to *Step 17*	Go to *Symptoms - Park Brake on page 5-244*
17	Install or connect any components that were removed or disconnected during diagnosis. Did you complete the operation?	Park Brake System OK	Go to *Symptoms - Park Brake on page 5-244*

Park Brake Hardware Inspection

Warning: Refer to Brake Dust Warning on page 0-4.

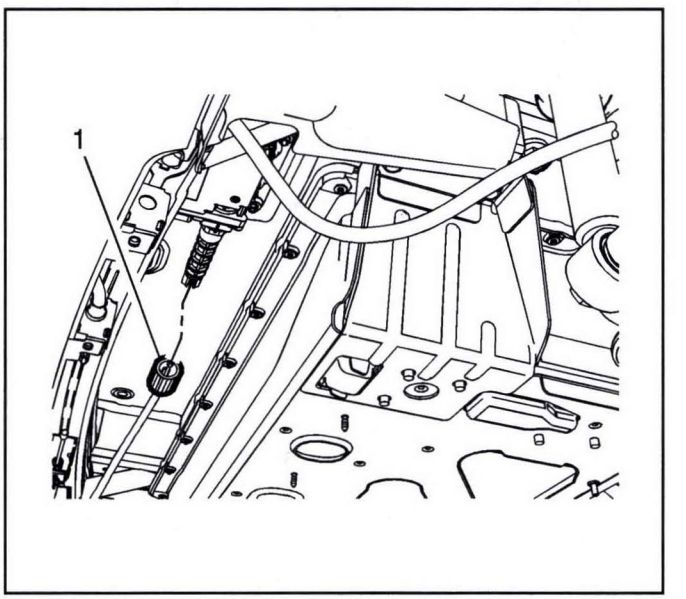
1. With the brake rotors removed, visually inspect the upper return/adjuster actuator spring and the lower return spring for the following:
   - Excessive corrosion
   - Excessive stretching
   - Broken hook ends
   - Twisting or binding
2. If any of the conditions listed were found, which could lead to improper park brake apply and/or release, the adjuster hardware and/or return springs require replacement.
3. Visually inspect the adjuster and the adjuster actuator lever for the following:
   - Misalignment with the park brake lever
   - Misalignment with the park brake shoes
   - Broken or bent adjuster actuator lever
   - Bent adjuster actuator lever pivot pin
4. If any of the conditions listed were found, which could lead to improper park brake apply and/or release, the adjuster hardware requires repair or replacement.
5. Inspect the park brake lever for the following:
   - Bent
   - Broken pivot pin
   - Seized at the pivot pin
   - Broken at park brake cable attachment
   - Improper contact with the adjuster
6. If any of the conditions listed were found, which could lead to improper park brake apply and/or release, the park brake lever requires repair or replacement.
7. Visually inspect the park brake cable for the following:
   - Improper mounting to the backing plate
   - Improper mounting at the park brake lever
   - Broken or missing cable end lug
8. If any of the conditions listed were found, which could lead to improper park brake apply and/or release, the park brake cable requires repair or replacement.
9. Apply the park brake lever/pedal three clicks.
10. Visually inspect the park brake cable for the following:
    - Unequal travel between the left and the right park brake systems
    - No travel on one or both of the park brake systems
11. If any of the conditions listed were found, which could lead to improper park brake apply and/or release, the park brake cable requires replacement and/or adjustment.
12. Release the park brake lever/pedal.
13. Visually inspect the park brake cable for the following:
    - Unequal release between the left and the right park brake systems
    - No release at one or both of the park brake systems
14. If any of the conditions listed were found, which could lead to improper park brake apply and/or release, the park brake cable requires replacement and/or adjustment.

Repair Instructions

Electronic Parking Brake Control Module Replacement

Removal Procedure

1. Place the transmission in PARK.
2. Disable the parking brake cable adjuster. Refer to *Parking Brake Cable Adjuster Disabling on page 5-264*.
3. Place the power button in the OFF position.
4. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
5. Remove the underbody rear air rear deflector. Refer to *Underbody Rear Air Rear Deflector Replacement (Rear) on page 3-129* or *Underbody Rear Air Rear Deflector Replacement (Front) on page 3-130*.



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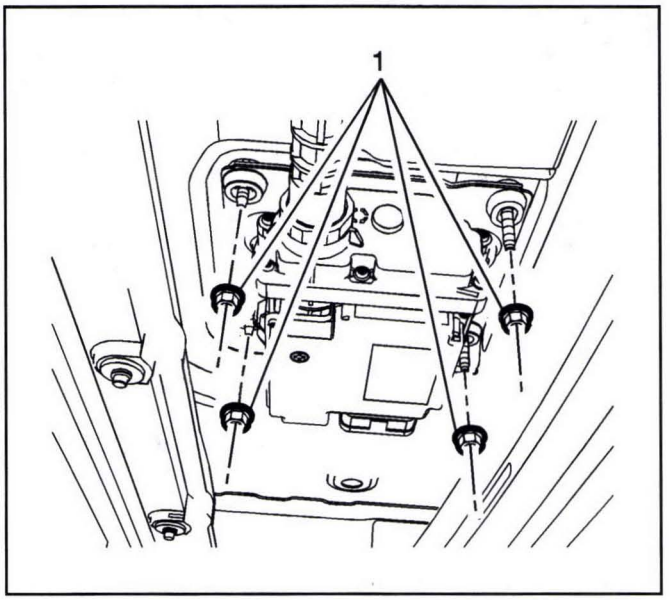
6. Remove the parking brake rear cable nut (1) from the electronic parking brake control module.
7. Disconnect the electronic parking brake control module electrical connector.



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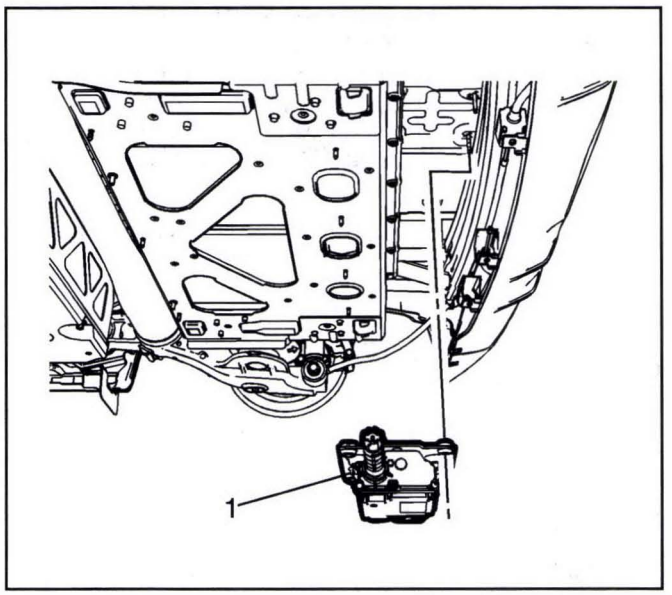
8. Remove the electronic parking brake control module bracket nuts (1).



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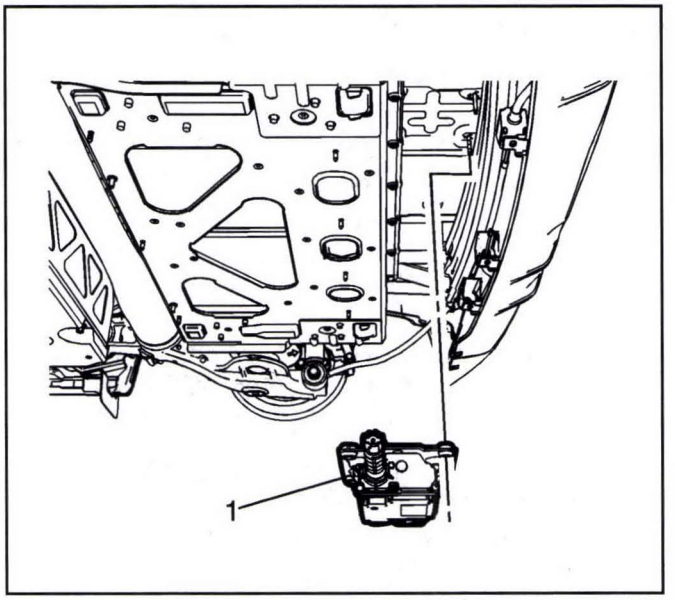
9. Lower the electronic parking brake control module (1) from the studs and maneuver the module past the rear impact bar.
10. Remove the electronic parking brake control module.

Installation Procedure

1. Maneuver the module past the rear impact bar.



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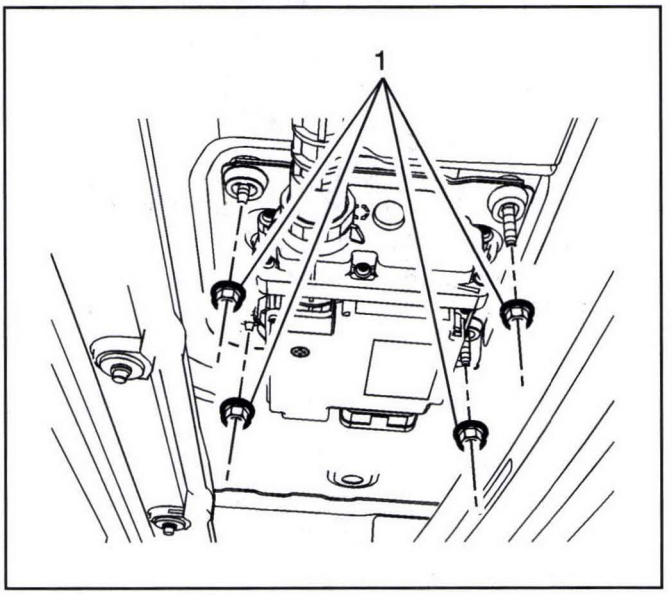
2. Install the electronic parking brake control module (1) to the studs on the vehicle underbody.



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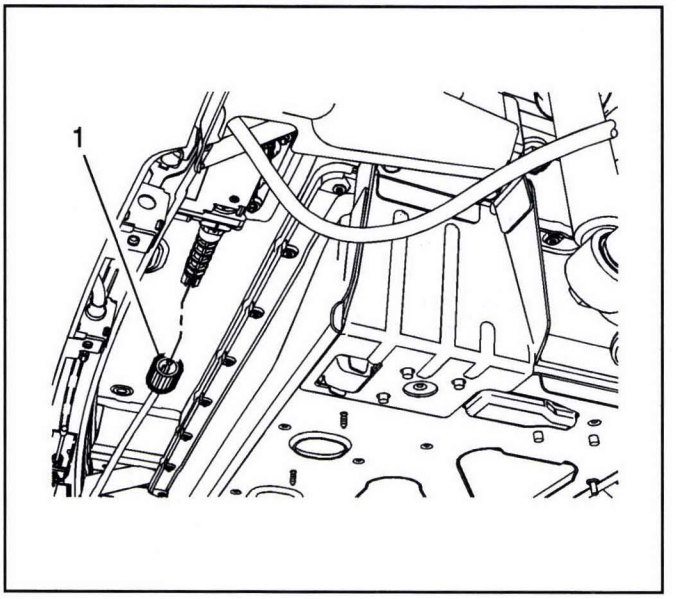
Caution: Refer to *Fastener Caution on page 0-8*.

3. Install the electronic parking brake control module bracket nuts (1) and tighten to **10 N•m (89 lb in)**.
4. Connect the electronic parking brake control module electrical connector.



3228706

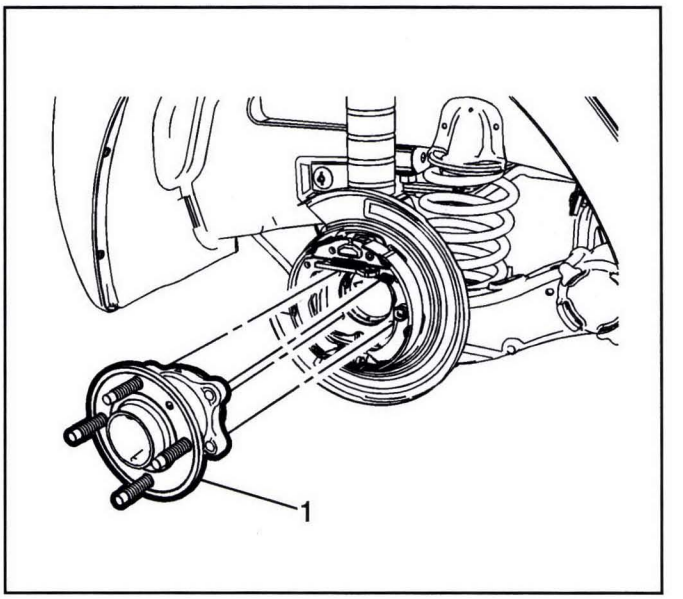
5. Install the parking brake rear cable nut (1) to the electronic parking brake control module and tighten to **6 N•m (53 lb in)**.
6. Install the underbody rear air rear deflector. Refer to *Underbody Rear Air Rear Deflector Replacement (Rear) on page 3-129* or *Underbody Rear Air Rear Deflector Replacement (Front) on page 3-130*.
7. Enable the parking brake cable adjuster. Refer to *Parking Brake Cable Adjuster Enabling on page 5-264*.
8. Program the electronic parking brake control module. Refer to *Electronic Parking Brake Control Module Programming and Setup on page 6-9*.

Parking Brake Shoe Replacement

Removal Procedure

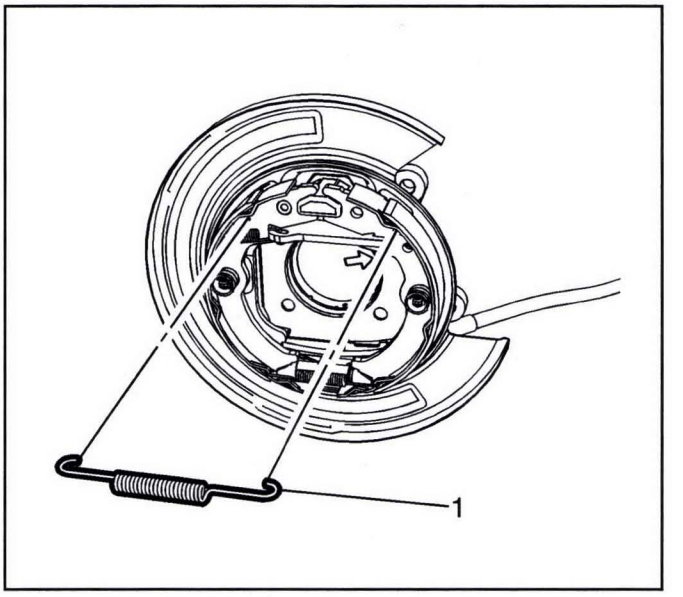
Warning: Refer to Brake Dust Warning on page 0-4.

1. Place the transmission in PARK.
2. Disable the parking brake cable adjuster. Refer to *Parking Brake Cable Adjuster Disabling on page 5-264*.
3. Place the power button in the OFF position.
4. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
5. Remove the underbody rear air rear deflector. Refer to *Underbody Rear Air Rear Deflector Replacement (Rear) on page 3-129* or *Underbody Rear Air Rear Deflector Replacement (Front) on page 3-130*.
6. Disconnect the parking brake rear cable from the left and right side parking brake rear cables. Refer to *Parking Brake Rear Cable Replacement on page 5-254*.
7. Disconnect the left and right side parking brake rear cables from the underbody brackets. Refer to *Parking Brake Rear Cable Replacement - Left Side on page 5-256* and *Parking Brake Rear Cable Replacement - Right Side on page 5-258*.



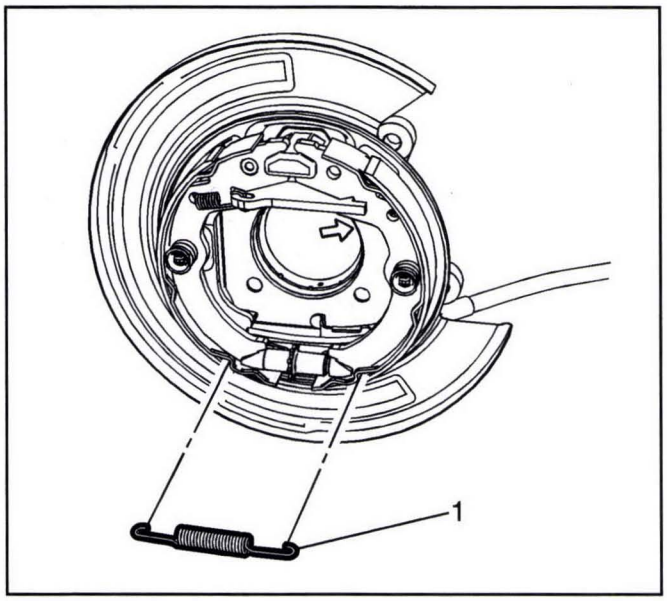
3416281

8. Remove the rear wheel bearing and hub assembly (1). Refer to *Rear Wheel Bearing and Hub Replacement on page 15-19*.
9. Place the rear parking brake anchor backing plate and parking brake rear cable assembly on a workbench.



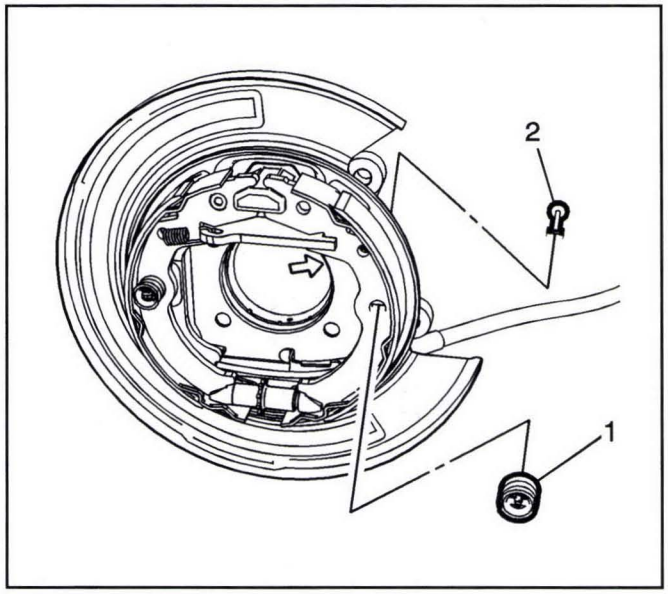
3415642

10. Remove the parking brake shoe return spring (1).



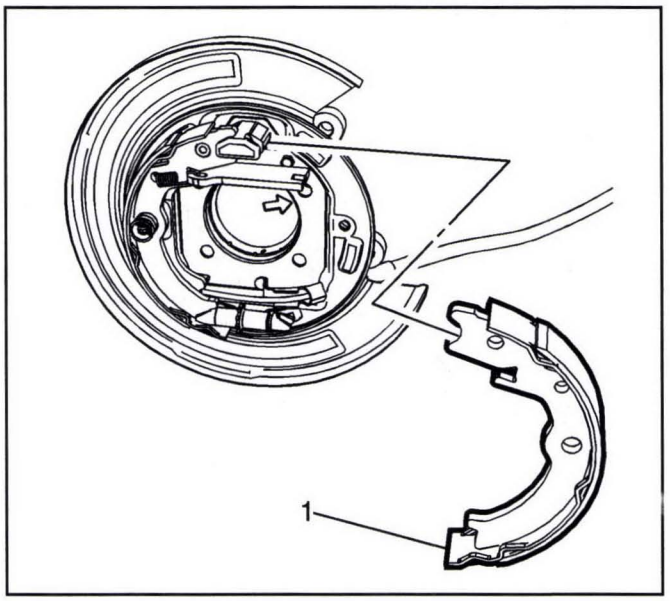
3415645

11. Remove the parking brake shoe adjuster spring (1).



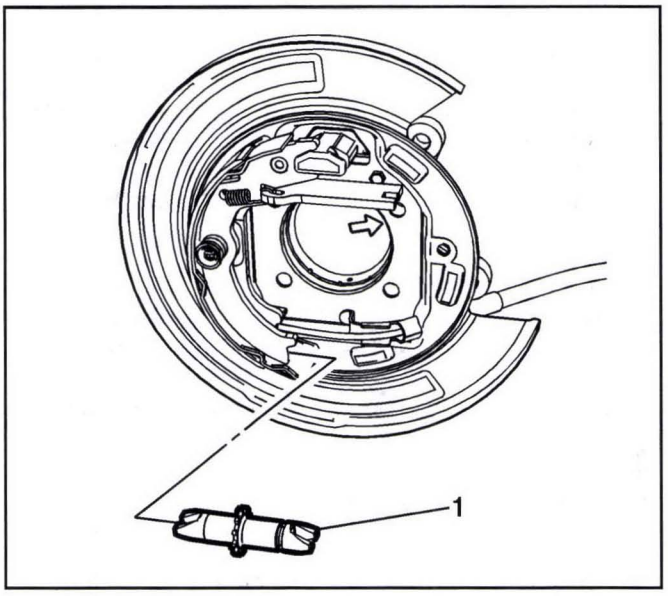
3415647

12. Compress the rear parking brake shoe hold down spring (1).
13. Rotate the compressed parking brake shoe hold down spring ¼ turn, and remove the spring and the hold down spring pin (2).



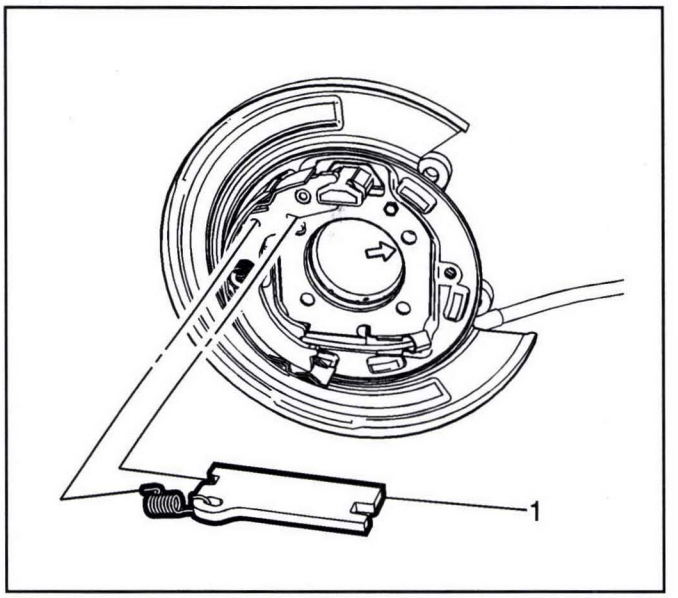
3415649

14. Remove the rear parking brake shoe (1).



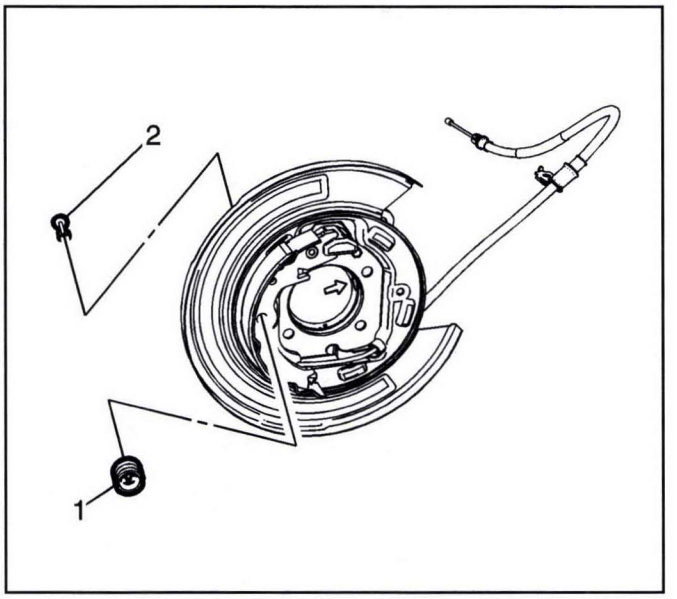
3415655

15. Remove the parking brake shoe adjuster (1).



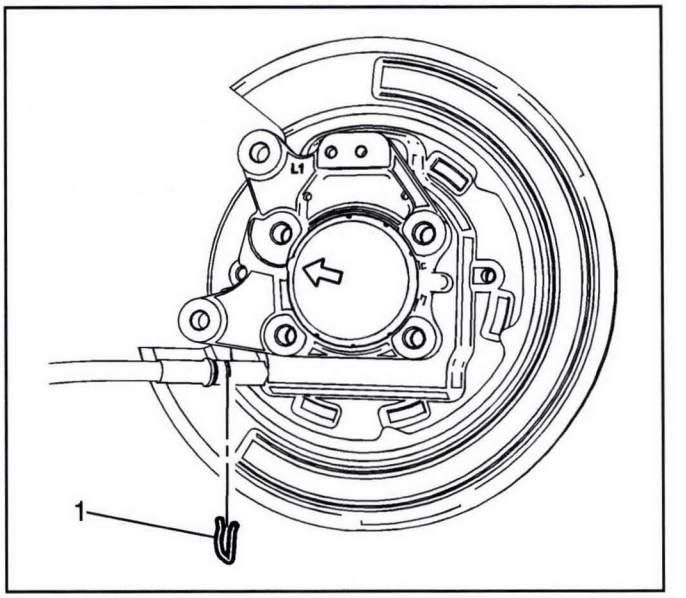
3415659

16. Remove the parking brake shoe lever return spring and lever (1).



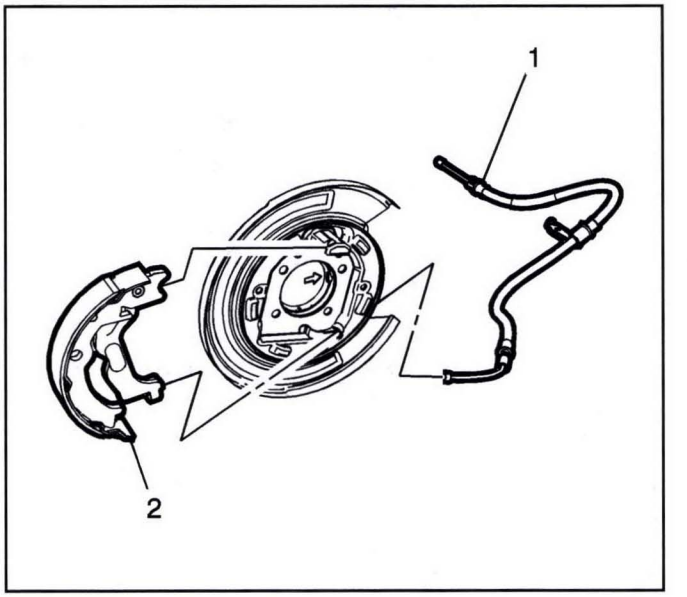
3415664

17. Compress the rear parking brake shoe hold down spring (1).
18. Rotate the compressed parking brake shoe hold down spring ¼ turn, and remove the spring and the hold down spring pin (2).



3415715

19. Remove the parking brake rear cable retainer (1).

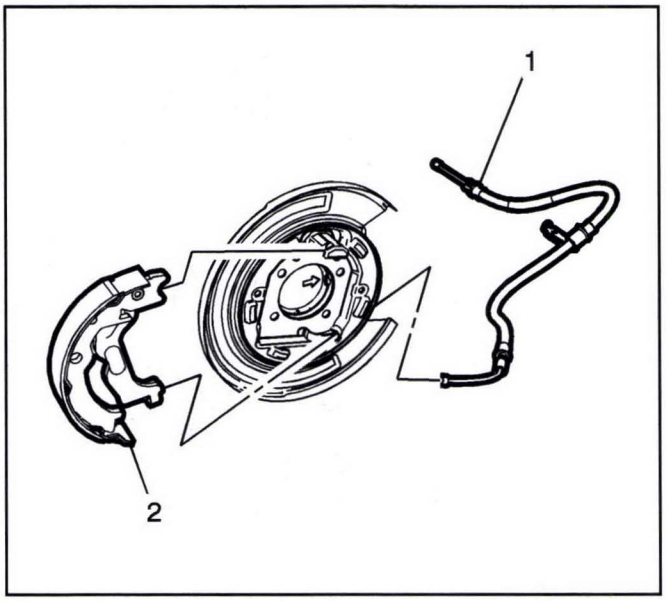


3415717

20. Disconnect the parking brake rear cable (1) from the parking brake shoe apply lever and remove the front parking brake shoe (2).
21. Clean the rear parking brake anchor backing plate with denatured alcohol and allow to dry.

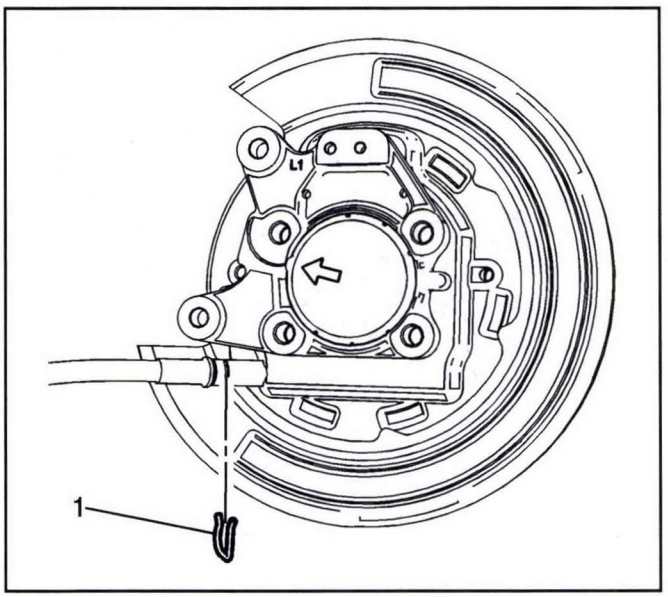
Installation Procedure

1. Apply a light coat of high temperature brake lubricant to the parking brake shoe contact points on the rear parking brake anchor backing plate.
2. Install the parking brake rear cable to the rear parking brake anchor backing plate.



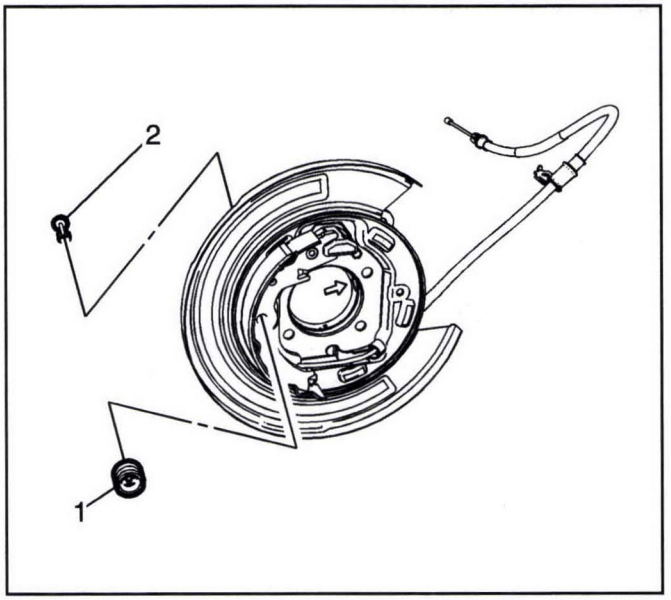
3415717

3. Connect the parking brake rear cable (1) to the parking brake shoe apply lever and install the front parking brake shoe (2).



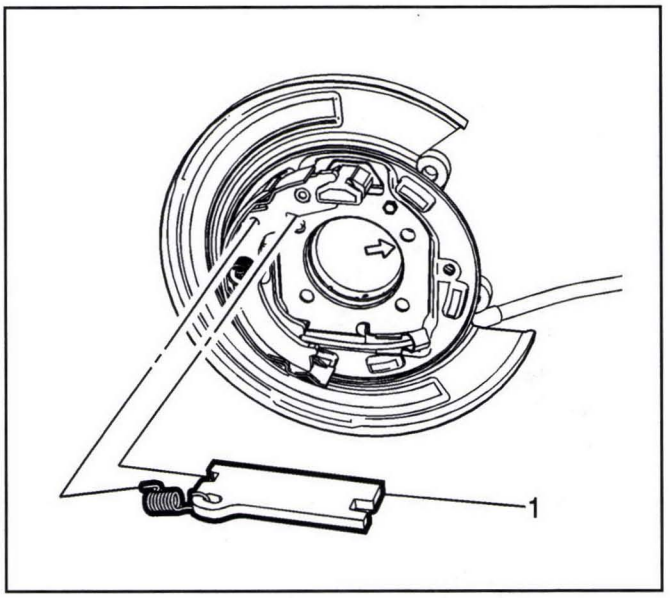
3415715

4. Install the parking brake rear cable retainer (1).



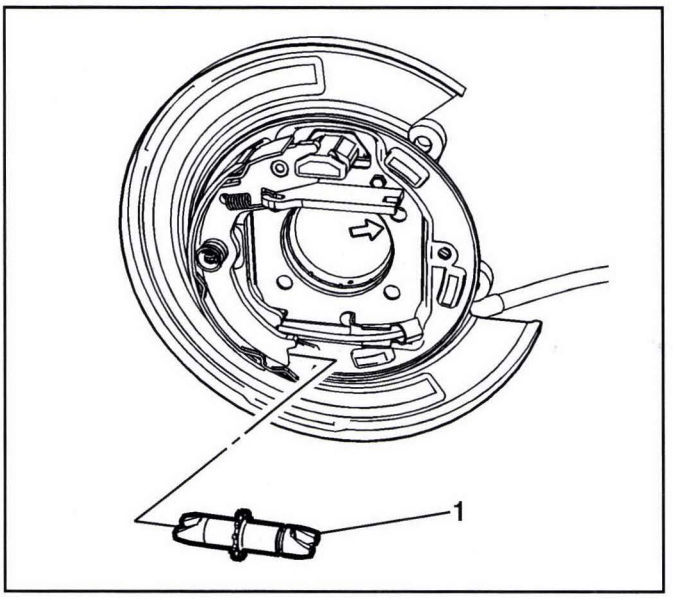
3415664

5. Compress the parking brake shoe hold down spring (1).
6. Install the parking brake shoe hold down spring pin (2) and rotate the spring ¼ turn to engage the pin in the hold down spring cup recess.



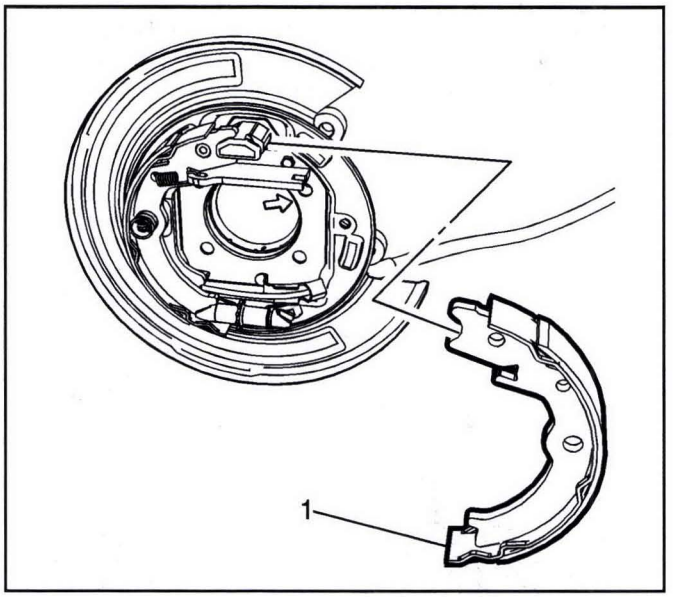
3415659

7. Install the parking brake shoe lever return spring and lever (1).



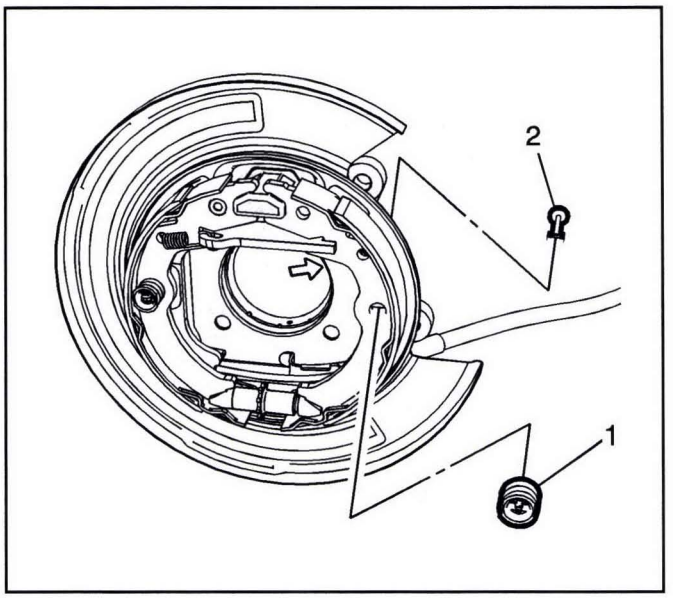
3415655

8. Install the rear parking brake shoe adjuster (1).



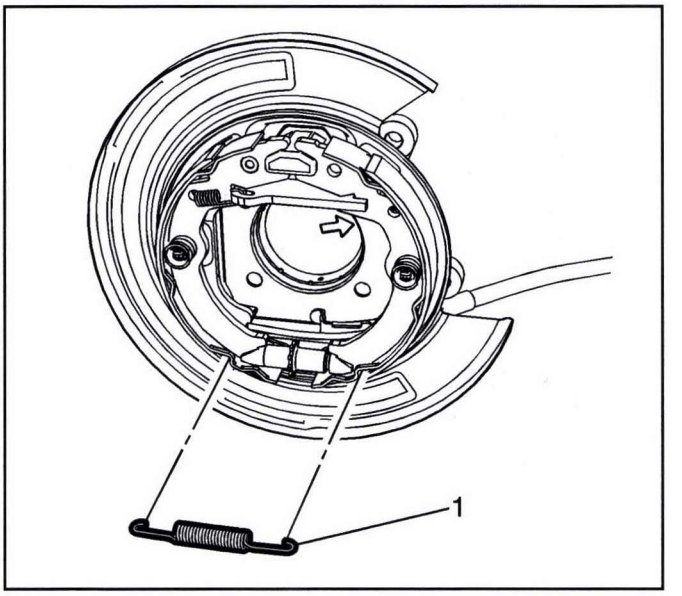
3415649

9. Install the rear parking brake shoe (1).



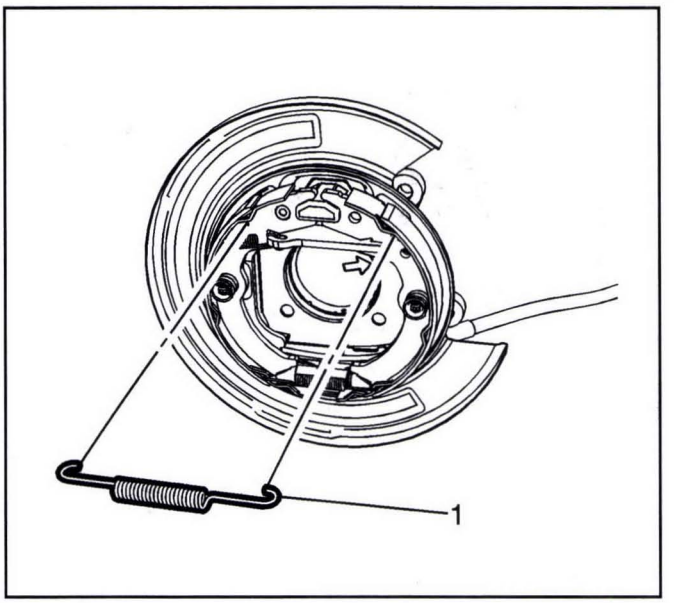
3415647

10. Compress the rear parking brake shoe hold down spring (1).
11. Install the parking brake shoe hold down spring pin (2) and rotate the spring ¼ turn to engage the pin in the hold down spring cup recess.



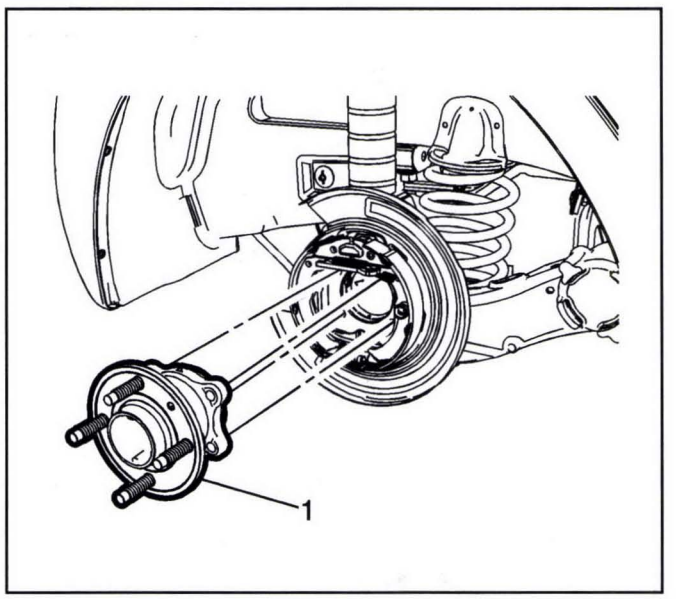
3415645

12. Install the parking brake shoe adjuster spring (1).



3415642

13. Install the parking brake shoe return spring (1).
14. Position the rear parking brake anchor backing plate and parking brake rear cable assembly to the rear axle.



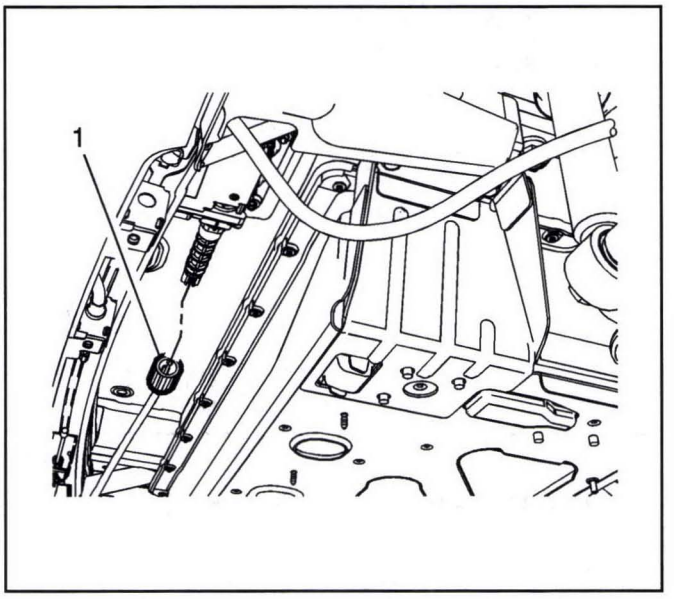
3416281

15. Install the rear wheel bearing and hub assembly (1). Refer to *Rear Wheel Bearing and Hub Replacement on page 15-19*.
16. Install the left and right side parking brake rear cables to the underbody brackets. Refer to *Parking Brake Rear Cable Replacement - Left Side on page 5-256* and *Parking Brake Rear Cable Replacement - Right Side on page 5-258*.
17. Install the parking brake rear cable to the left and right side parking brake rear cables. Refer to *Parking Brake Rear Cable Replacement on page 5-254*.
18. Install the underbody rear air rear deflector. Refer to *Underbody Rear Air Rear Deflector Replacement (Rear) on page 3-129* or *Underbody Rear Air Rear Deflector Replacement (Front) on page 3-130*.
19. Adjust the parking brake. Refer to *Parking Brake Adjustment on page 5-267*.
20. Enable the parking brake cable adjuster. Refer to *Parking Brake Cable Adjuster Enabling on page 5-264*.

Parking Brake Rear Cable Replacement

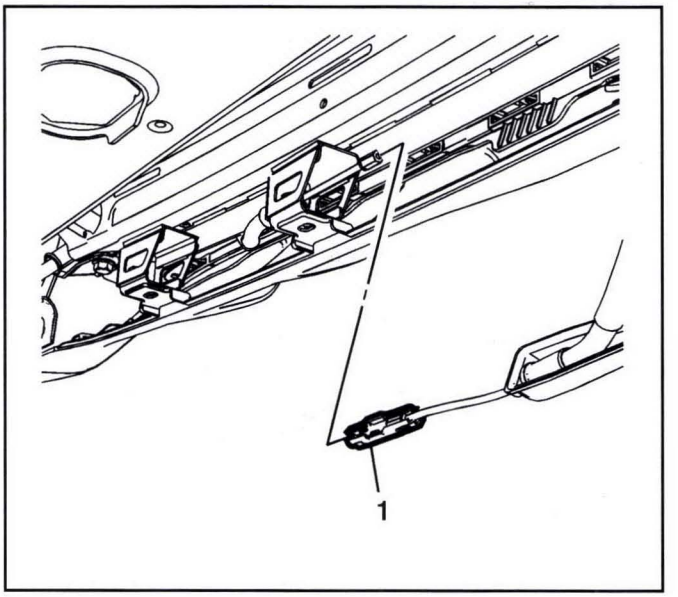
Removal Procedure

1. Place the transmission in PARK.
2. Disable the parking brake cable adjuster. Refer to *Parking Brake Cable Adjuster Disabling on page 5-264*.
3. Place the power button in the OFF position.
4. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
5. Remove the underbody rear air rear deflector. Refer to *Underbody Rear Air Rear Deflector Replacement (Rear) on page 3-129* or *Underbody Rear Air Rear Deflector Replacement (Front) on page 3-130*.



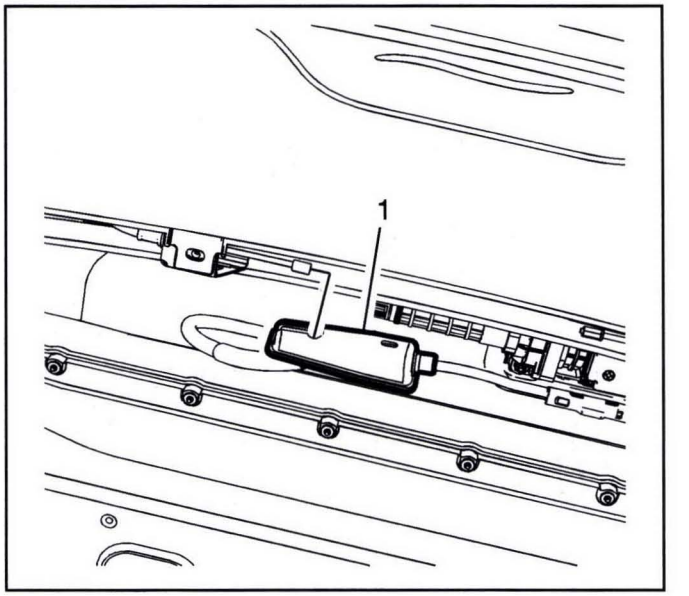
3228706

6. Remove the parking brake rear cable nut (1) from the electronic parking brake control module.



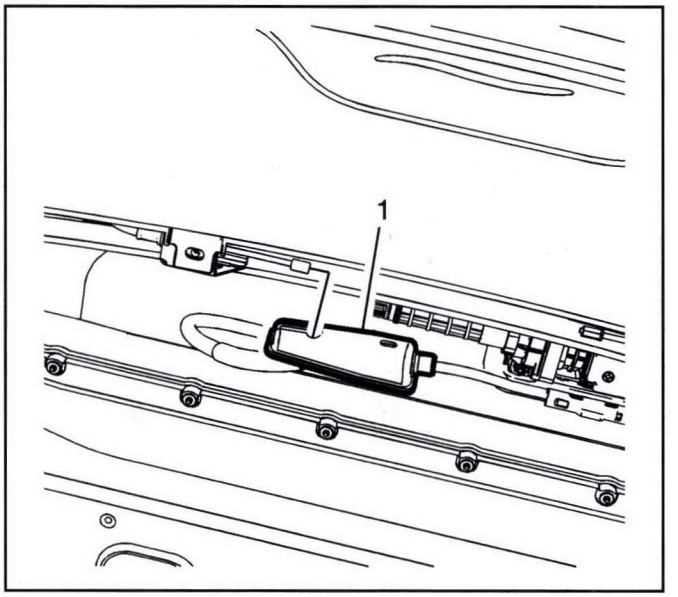
3228768

7. Disconnect the parking brake rear cable connector (1) from the right side parking brake rear cable.



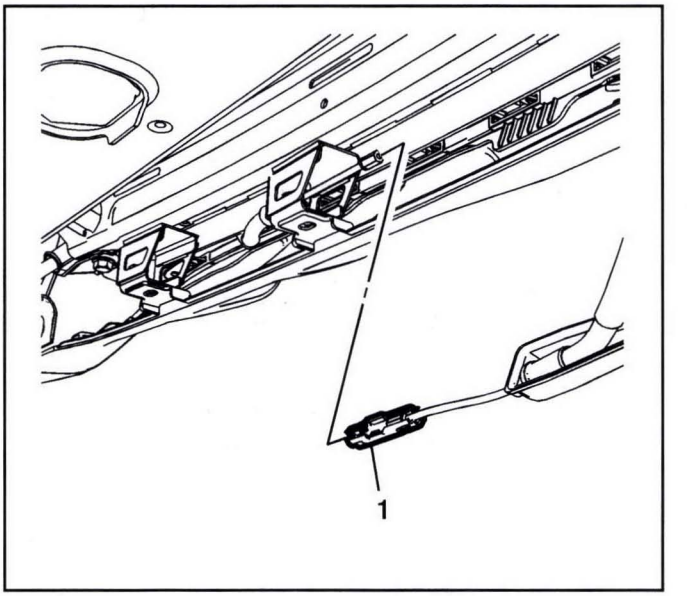
3228769

2. Connect the parking brake rear cable equalizer (1) to the left side parking brake rear cable.



3228769

8. Disconnect the parking brake rear cable equalizer (1) from the left side parking brake rear cable.
9. Remove the parking brake rear cable from the vehicle.

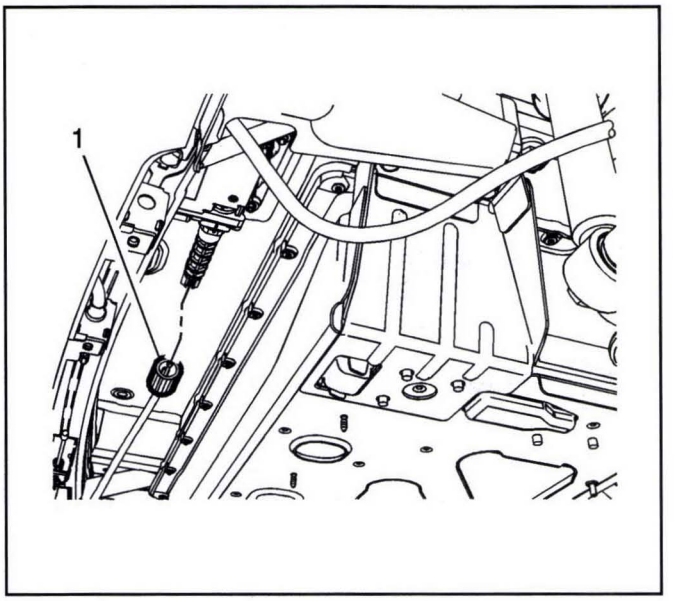


3228768

3. Connect the parking brake rear cable connector (1) to the right side parking brake rear cable.

Installation Procedure

1. Install the parking brake rear cable to the vehicle.



3228706

Caution: Refer to *Fastener Caution on page 0-8*.

4. Install the parking brake rear cable nut (1) to the electronic parking brake control module and tighten to **6 N•m (53 lb in)**.
5. Install the underbody rear air rear deflector. Refer to *Underbody Rear Air Rear Deflector Replacement (Rear) on page 3-129* or *Underbody Rear Air Rear Deflector Replacement (Front) on page 3-130*.
6. Enable the parking brake cable adjuster. Refer to *Parking Brake Cable Adjuster Enabling on page 5-264*.

Parking Brake Rear Cable Replacement - Left Side

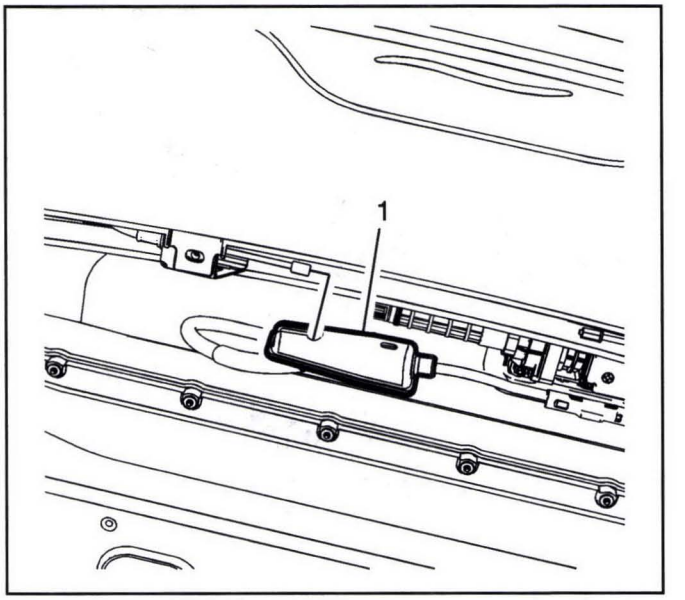
Special Tools

CH-37043 Parking Brake Cable Release Tool

For equivalent regional tools, refer to *Special Tools on page 5-269*.

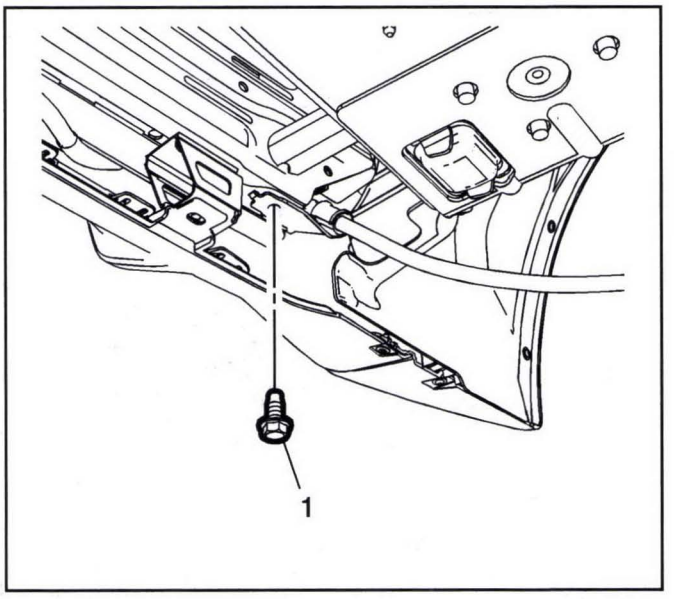
Removal Procedure

1. Place the transmission in PARK.
2. Disable the parking brake cable adjuster. Refer to *Parking Brake Cable Adjuster Disabling on page 5-264*.
3. Place the power button in the OFF position.
4. Remove the underbody rear air rear deflector. Refer to *Underbody Rear Air Rear Deflector Replacement (Rear) on page 3-129* or *Underbody Rear Air Rear Deflector Replacement (Front) on page 3-130*.



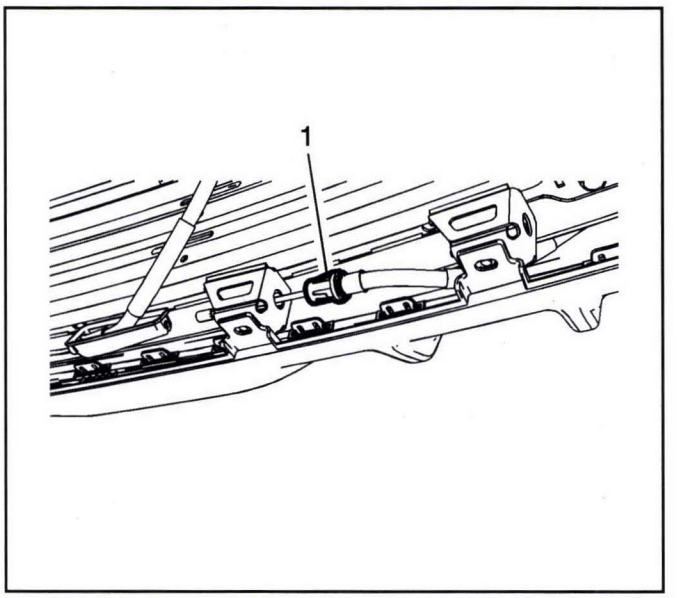
3228769

5. Disconnect the parking brake rear cable equalizer (1) from the left side parking brake rear cable.



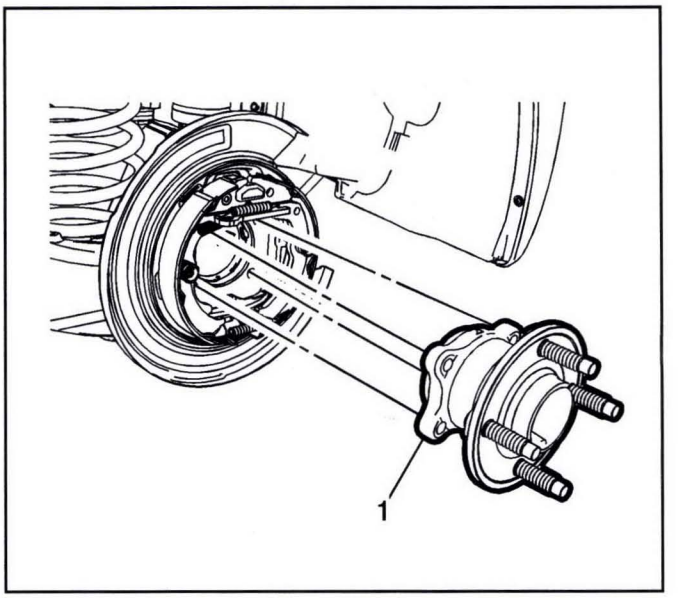
3228770

6. Remove the left rear parking brake cable bracket bolt (1).



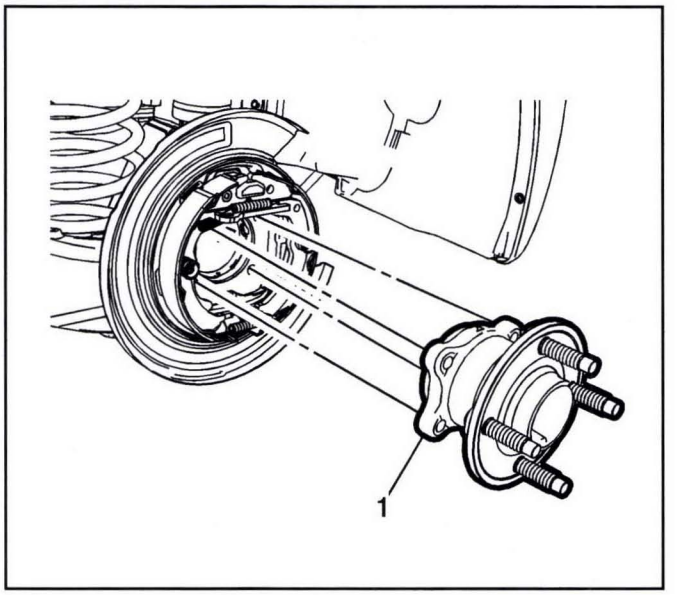
3228795

7. Using the *CH-37043* Parking Brake Cable Release Tool, release the left rear parking brake cable retainer (1) from the underbody bracket.



3416282

3. Install the left rear wheel bearing and hub assembly (1). Refer to *Rear Wheel Bearing and Hub Replacement on page 15-19*.

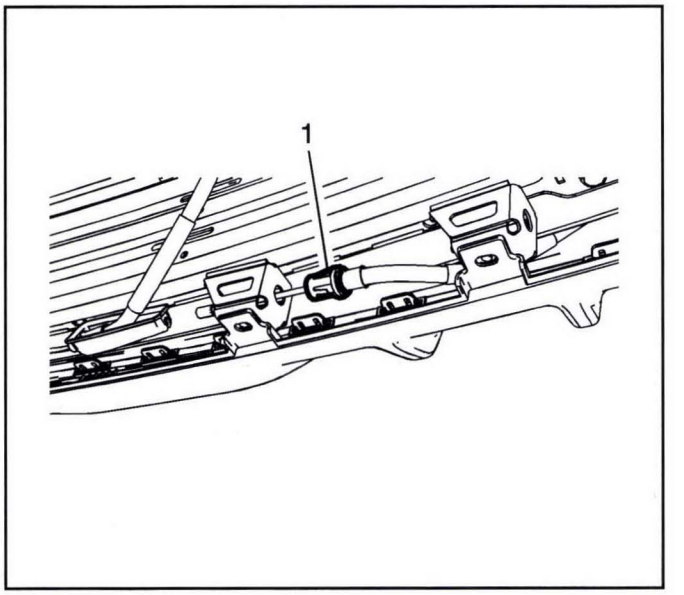


3416282

8. Remove the left rear wheel bearing and hub assembly (1). Refer to *Rear Wheel Bearing and Hub Replacement on page 15-19*.
9. Remove the left side parking brake shoe and cable assembly. Refer to *Parking Brake Shoe Replacement on page 5-249*.

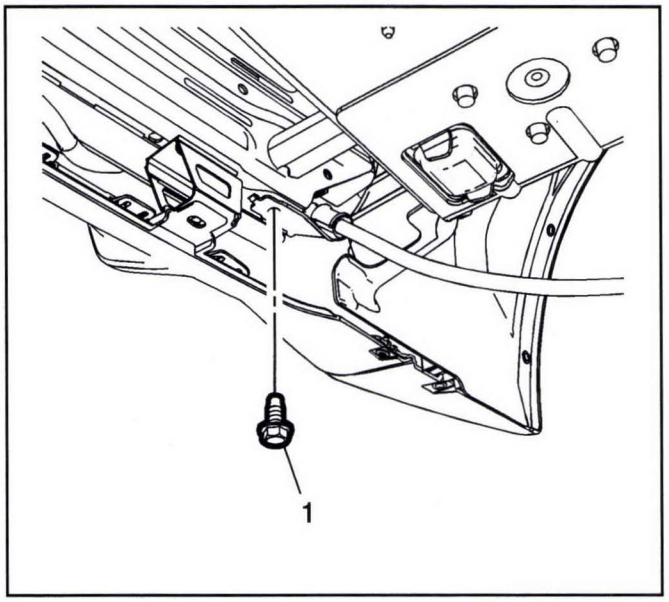
Installation Procedure

1. Install the left side parking brake shoe and cable assembly. Refer to *Parking Brake Shoe Replacement on page 5-249*.
2. Ensure the left rear parking brake cable retainer is fully seated in the parking brake cable.



3228795

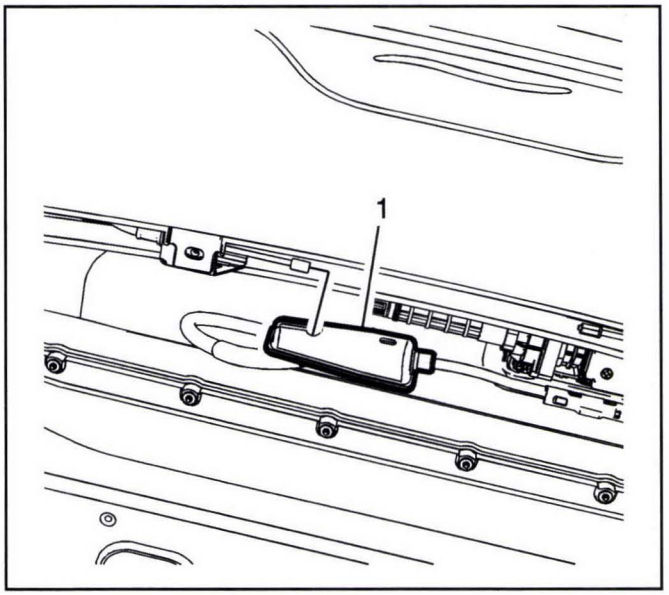
4. Install the left rear parking brake cable retainer (1) to the underbody bracket.
5. Ensure the left rear parking brake cable retainer is fully seated in the underbody bracket.



3228770

Caution: Refer to *Fastener Caution on page 0-8*.

6. Install the left rear parking brake cable bracket bolt (1) and tighten to **22 N•m (16 lb ft)**.



3228769

7. Connect the parking brake rear cable equalizer (1) to the left side parking brake rear cable.
8. Install the underbody rear air rear deflector. Refer to *Underbody Rear Air Rear Deflector Replacement (Rear) on page 3-129* or *Underbody Rear Air Rear Deflector Replacement (Front) on page 3-130*.
9. Enable the parking brake cable adjuster. Refer to *Parking Brake Cable Adjuster Enabling on page 5-264*.

Parking Brake Rear Cable Replacement - Right Side

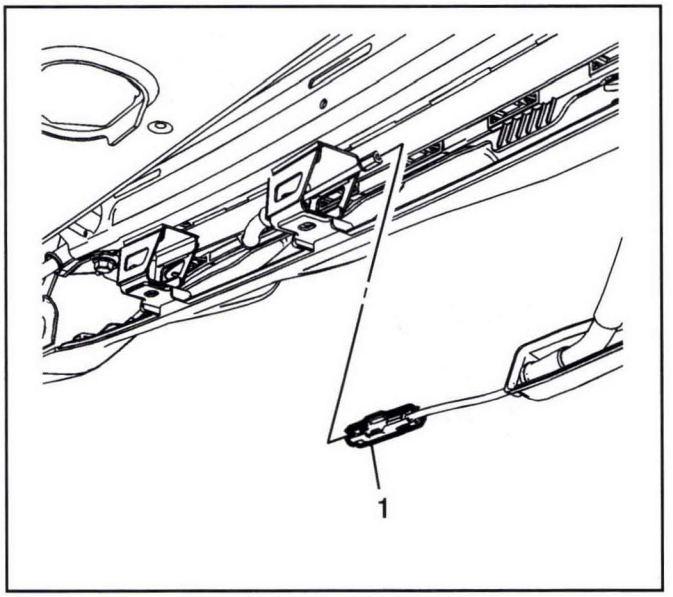
Special Tools

CH-37043 Parking Brake Cable Release Tool

For equivalent regional tools, refer to *Special Tools on page 5-269*.

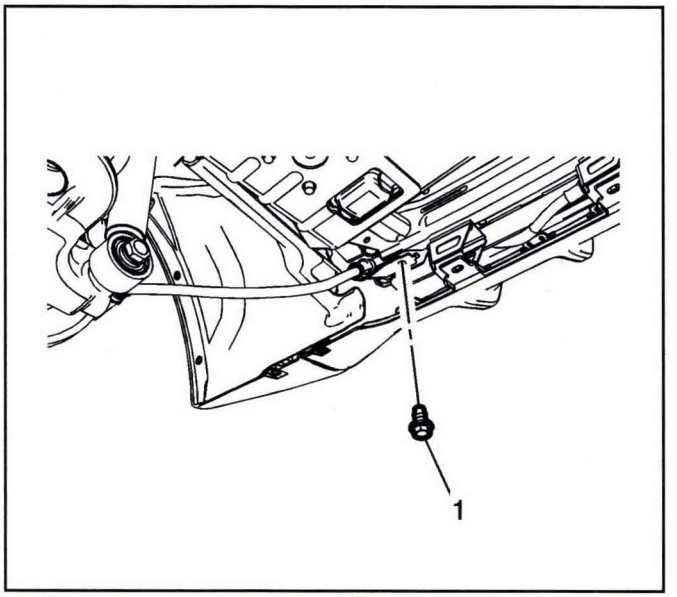
Removal Procedure

1. Place the transmission in PARK.
2. Disable the parking brake cable adjuster. Refer to *Parking Brake Cable Adjuster Disabling on page 5-264*.
3. Place the power button in the OFF position.
4. Remove the underbody rear air rear deflector. Refer to *Underbody Rear Air Rear Deflector Replacement (Rear) on page 3-129* or *Underbody Rear Air Rear Deflector Replacement (Front) on page 3-130*.



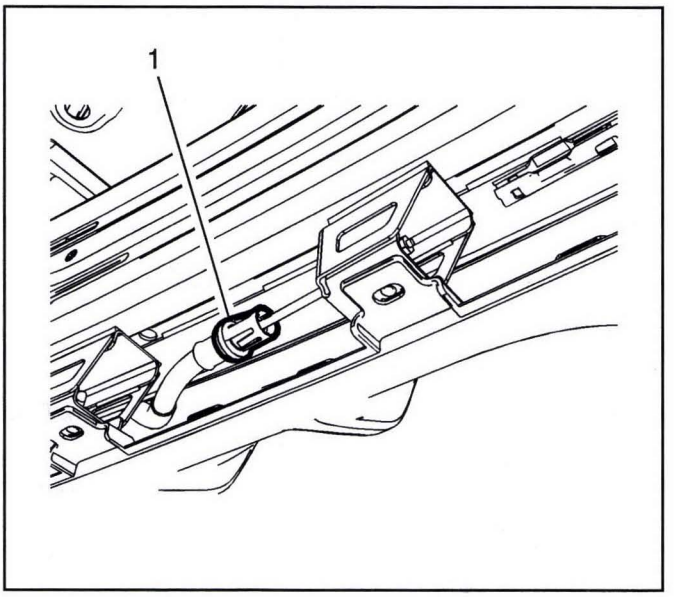
3228768

5. Disconnect the parking brake rear cable connector (1) from the right side parking brake rear cable.



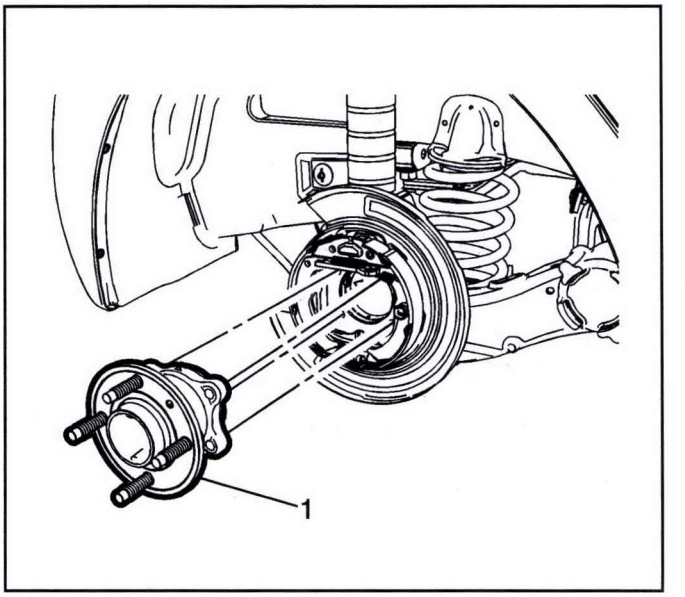
3228821

6. Remove the right rear parking brake cable bracket bolt (1).



3228823

7. Using the *CH-37043* Parking Brake Cable Release Tool, release the right rear parking brake cable retainer (1) from the underbody bracket.

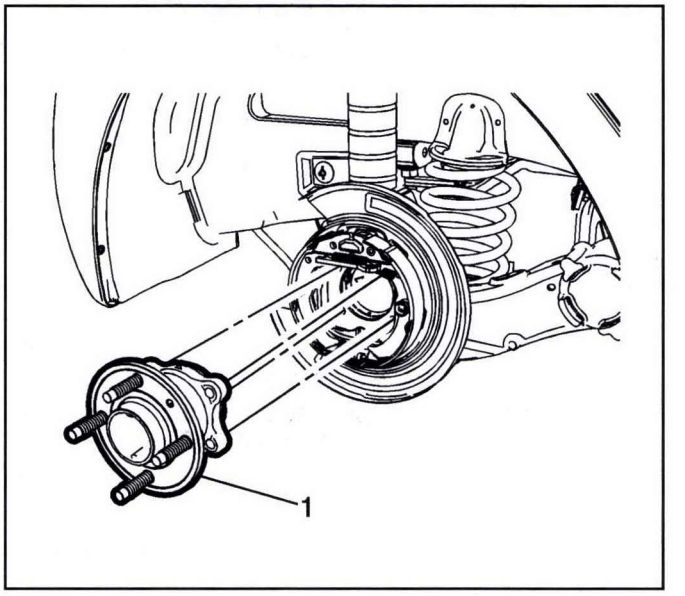


3416281

8. Remove the right rear wheel bearing and hub assembly (1). Refer to *Rear Wheel Bearing and Hub Replacement on page 15-19*.
9. Remove the right side parking brake shoe and cable assembly. Refer to *Parking Brake Shoe Replacement on page 5-249*.

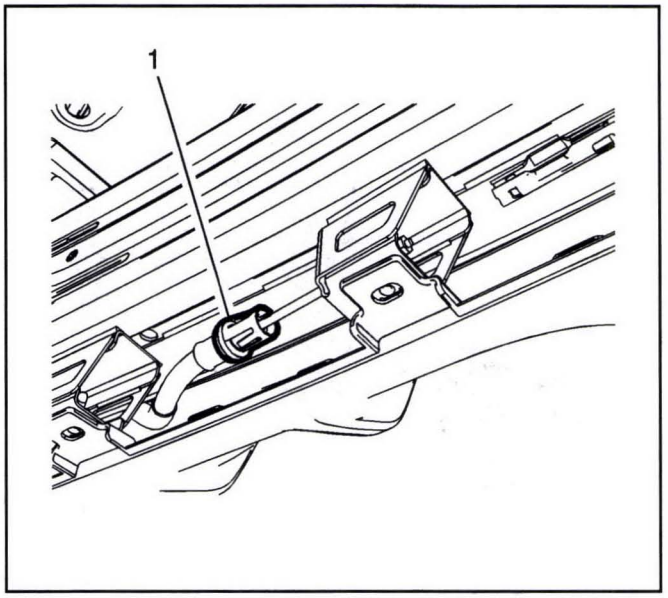
Installation Procedure

1. Install the right side parking brake shoe and cable assembly. Refer to *Parking Brake Shoe Replacement on page 5-249*.
2. Ensure the right rear parking brake cable retainer is fully seated in the parking brake cable.



3416281

3. Install the right rear wheel bearing and hub assembly (1). Refer to *Rear Wheel Bearing and Hub Replacement on page 15-19*.



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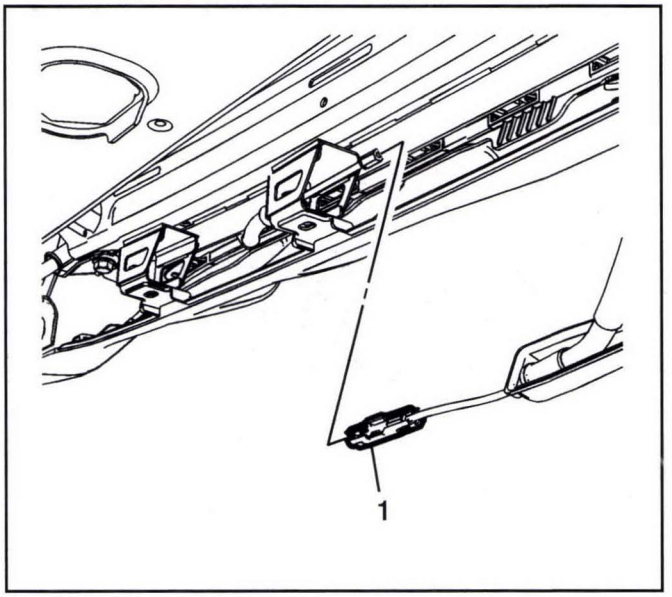
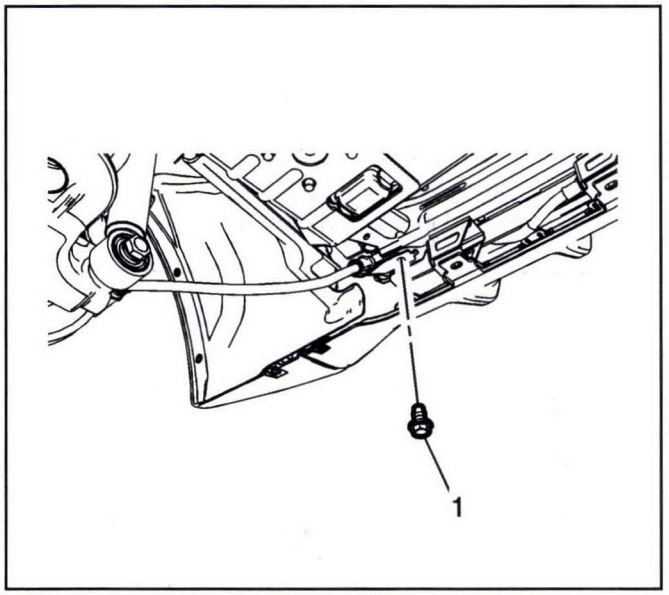


3228768

4. Install the right rear parking brake cable retainer (1) to the underbody bracket.
5. Ensure the right rear parking brake cable retainer is fully seated in the underbody bracket.



3228821

Caution: Refer to *Fastener Caution on page 0-8*.

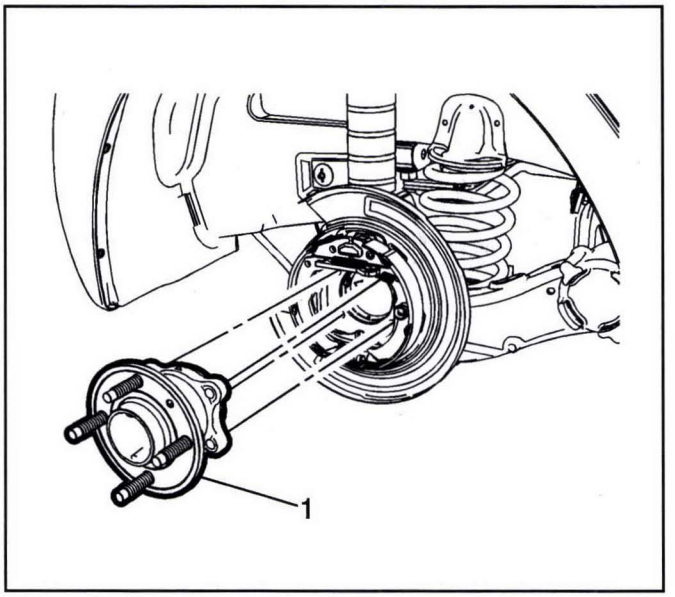
6. Install the right rear parking brake cable bracket bolt (1) and tighten to **22** N•m **(16 lb ft)**.
7. Connect the parking brake rear cable connector (1) to the right side parking brake rear cable.
8. Install the underbody rear air rear deflector. Refer to *Underbody Rear Air Rear Deflector Replacement (Rear) on page 3-129* or *Underbody Rear Air Rear Deflector Replacement (Front) on page 3-130*.
9. Enable the parking brake cable adjuster. Refer to *Parking Brake Cable Adjuster Enabling on page 5-264*.

Rear Parking Brake Adjuster Replacement

Removal Procedure

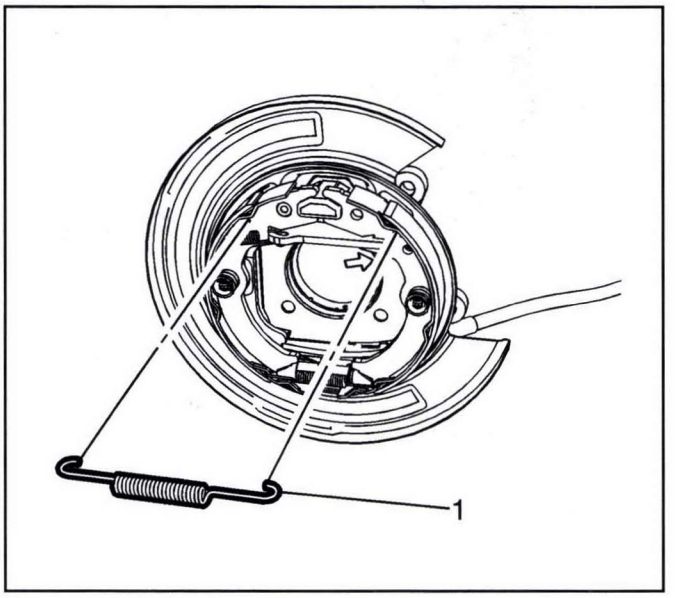
Warning: Refer to Brake Dust Warning on page 0-4.

1. Place the transmission in PARK.
2. Disable the parking brake cable adjuster. Refer to *Parking Brake Cable Adjuster Disabling on page 5-264*.
3. Place the power button in the OFF position.
4. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
5. Remove the underbody rear air rear deflector. Refer to *Underbody Rear Air Rear Deflector Replacement (Rear) on page 3-129* or *Underbody Rear Air Rear Deflector Replacement (Front) on page 3-130*.
6. Disconnect the parking brake rear cable from the left or right side parking brake rear cable. Refer to *Parking Brake Rear Cable Replacement on page 5-254*.
7. Disconnect the left or right side parking brake rear cable from the underbody brackets. Refer to *Parking Brake Rear Cable Replacement - Left Side on page 5-256* or *Parking Brake Rear Cable Replacement - Right Side on page 5-258*.



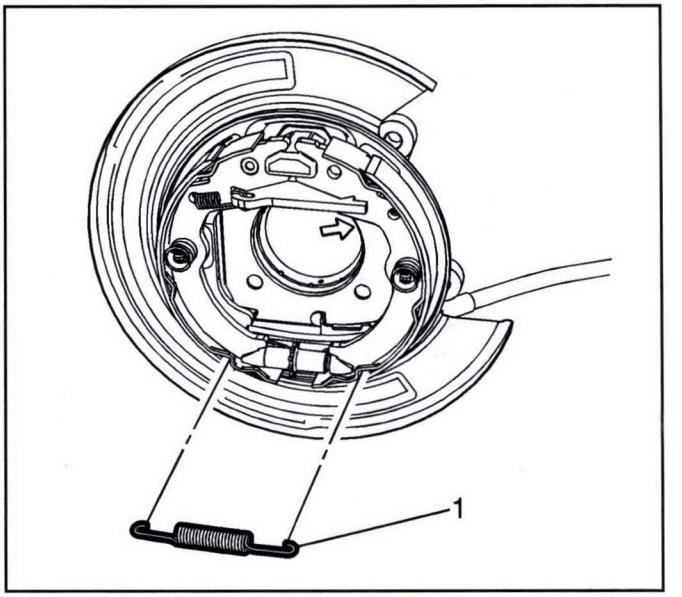
3416281

8. Remove the rear wheel bearing and hub assembly (1). Refer to *Rear Wheel Bearing and Hub Replacement on page 15-19*.
9. Place the rear parking brake anchor backing plate and parking brake rear cable assembly on a workbench.



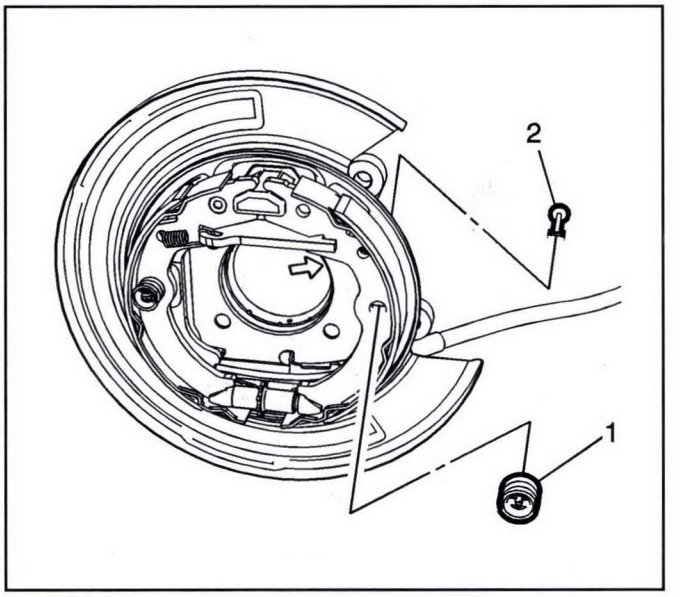
3415642

10. Remove the parking brake shoe return spring (1).



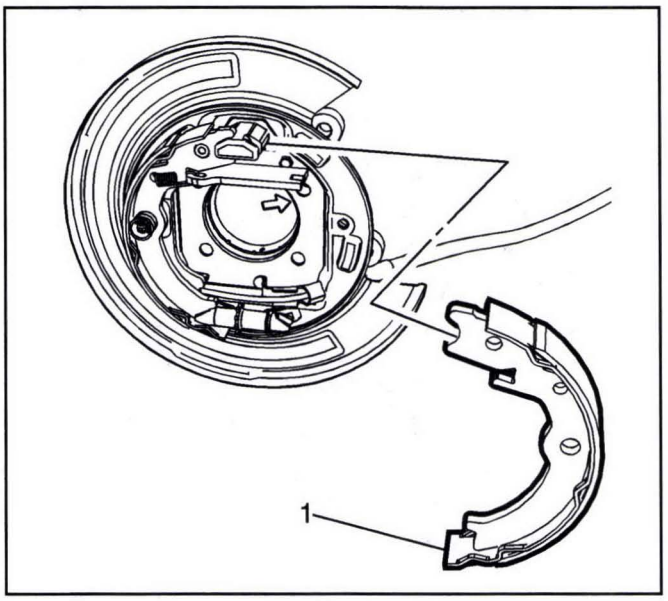
3415645

11. Remove the parking brake shoe adjuster spring (1).



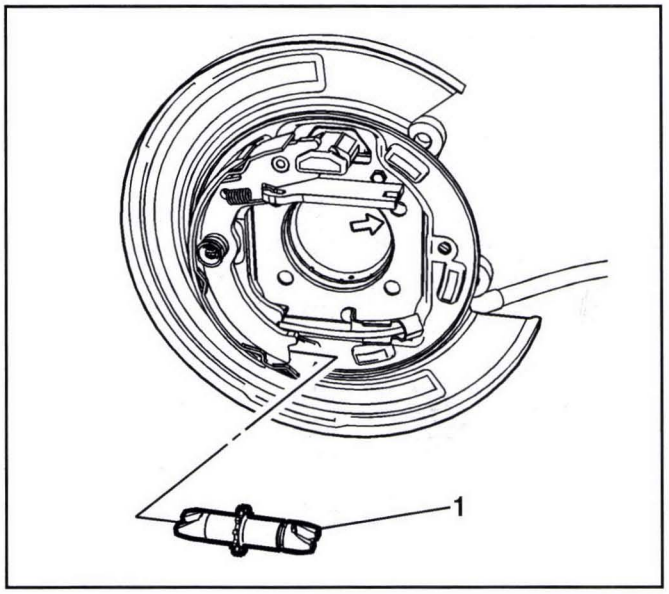
3415647

12. Compress the rear parking brake shoe hold down spring (1).
13. Rotate the compressed parking brake shoe hold down spring ¼ turn, and remove the spring and the hold down spring pin (2).



3415649

14. Remove the rear parking brake shoe (1).

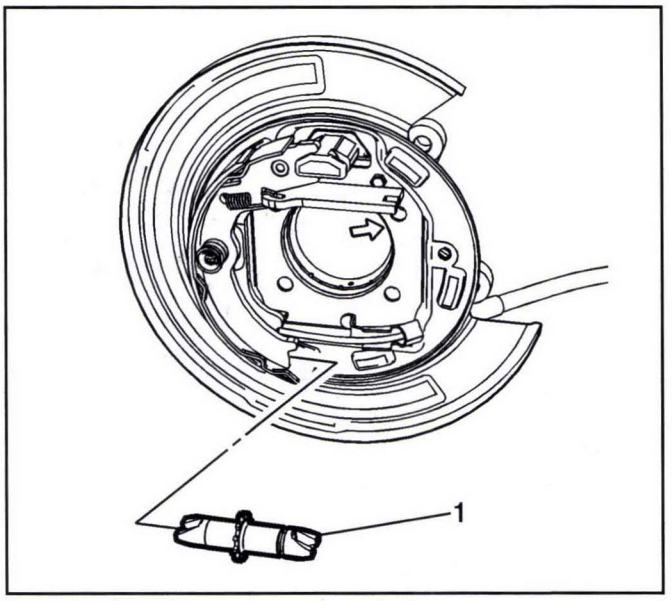


3415655

15. Remove the parking brake shoe adjuster (1).

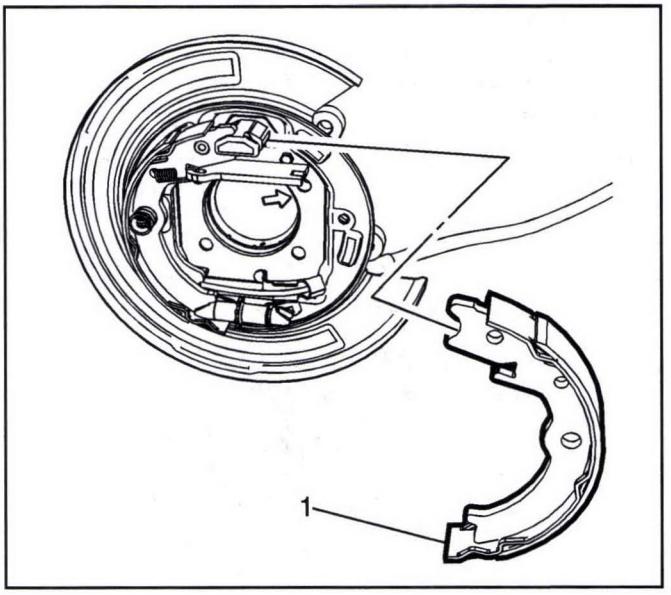
Installation Procedure

1. Rotate the parking brake shoe adjuster to the fully retracted position.



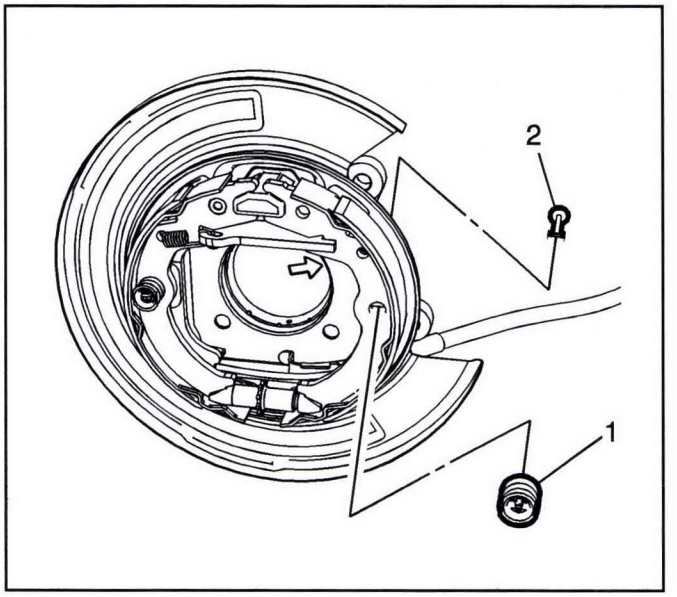
3415655

2. Install the parking brake shoe adjuster (1).



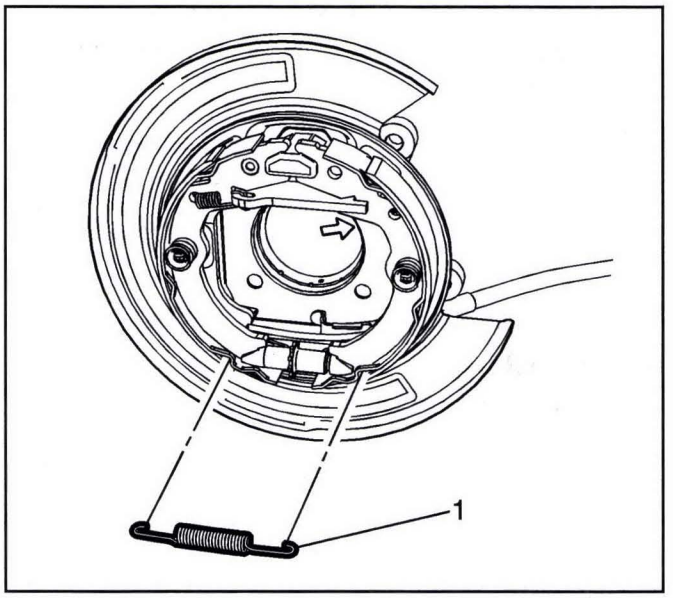
3415649

3. Install the rear parking brake shoe (1).



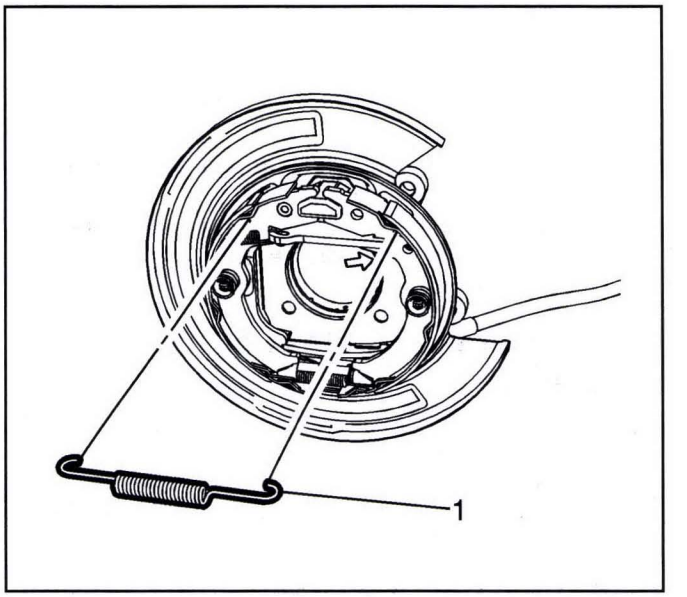
3415647

4. Compress the rear parking brake shoe hold down spring (1).
5. Install the parking brake shoe hold down spring pin (2) and rotate the spring ¼ turn to engage the pin in the hold down spring cup recess.



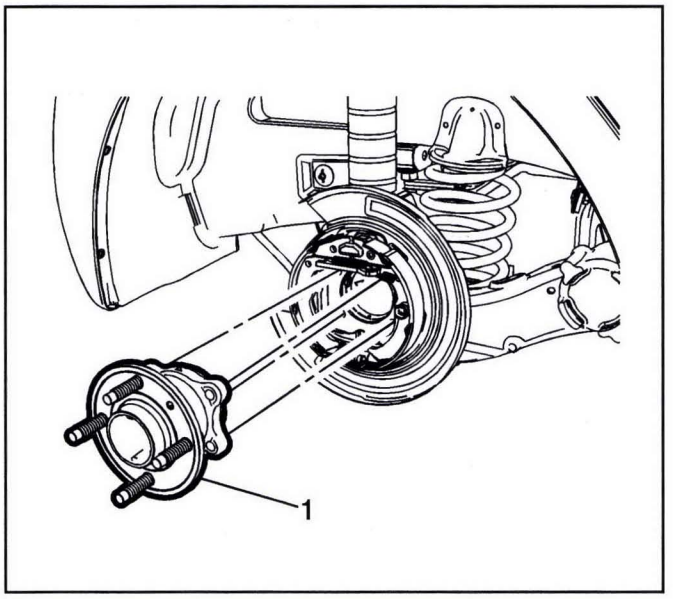
3415645

6. Install the parking brake shoe adjuster spring (1).



3415642

7. Install the parking brake shoe return spring (1).
8. Position the rear parking brake anchor backing plate and parking brake rear cable assembly to the rear axle.



3416281

9. Install the rear wheel bearing and hub assembly (1). Refer to *Rear Wheel Bearing and Hub Replacement on page 15-19*.
10. Install the left or right side parking brake rear cable to the underbody brackets. Refer to *Parking Brake Rear Cable Replacement - Left Side on page 5-256* or *Parking Brake Rear Cable Replacement - Right Side on page 5-258*.
11. Install the parking brake rear cable to the left or right side parking brake rear cable. Refer to *Parking Brake Rear Cable Replacement on page 5-254*.

12. Install the underbody rear air rear deflector. Refer to *Underbody Rear Air Rear Deflector Replacement (Rear) on page 3-129* or *Underbody Rear Air Rear Deflector Replacement (Front) on page 3-130*.
13. Adjust the parking brake. Refer to *Parking Brake Adjustment on page 5-267*.
14. Enable the parking brake cable adjuster. Refer to *Parking Brake Cable Adjuster Enabling on page 5-264*.

Parking Brake Cable Adjuster Disabling

The park brake cable tension is controlled by the electronic park brake (EPB) module. Tension can be fully released from the park brake cables to allow for service of the park brake system. Perform one of the following three methods to fully release cable tension.

Electronic Parking Brake Cable Tension Release

With Scan Tool - Preferred Method

1. Block the drive wheels.
2. Install a scan tool to the vehicle.
3. Place the transmission in PARK.
4. Place the power button in Service Only Mode.
5. Select Configuration/Reset Functions from the electronic parking brake control module menu.
6. Follow the instructions on the scan tool.

Without Scan Tool - Optional Method

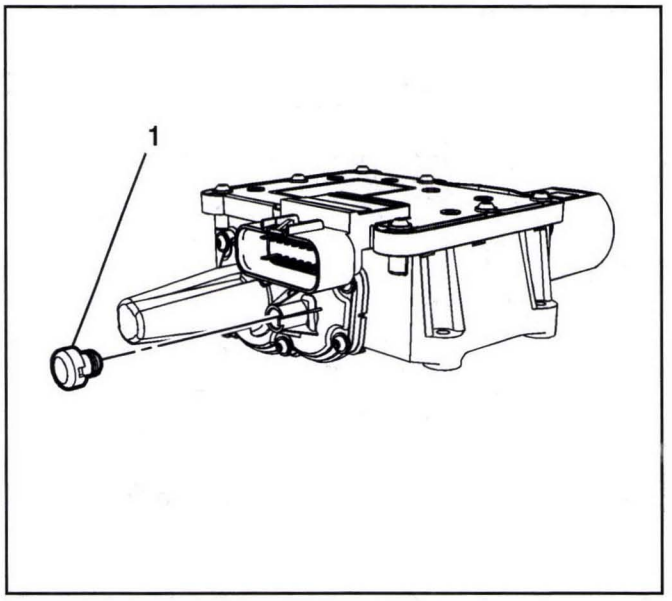
1. Block the drive wheels.
2. Place the transmission in PARK.
3. Place the power button in Service Only Mode.
4. Apply and hold the brake pedal. The brake pedal must remain applied throughout the park brake cable tension release process.
5. Press and hold down the electronic park brake (EPB) switch approximately 5 seconds.
6. Observe the PARK BRAKE lamp on the instrument cluster.
7. When the PARK BRAKE lamp flashes, release then immediately press and release the EPB switch.

   The parking brake cable tension is fully released.
8. Release the brake pedal.

Manual Parking Brake Cable Tension Release

In the event the above methods to release the parking brake cable tension are unsuccessful, the following procedure may be necessary to release the parking brake cable tension.

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
2. Remove the underbody rear air rear deflector. Refer to *Underbody Rear Air Rear Deflector Replacement (Rear) on page 3-129* or *Underbody Rear Air Rear Deflector Replacement (Front) on page 3-130*.



2378042

Note: The protective plug for the manual release is located near the electrical connector.

3. Remove the protective plug (1) from the EPB manual release.
4. Using an appropriate square-drive tool, rotate the mechanism clockwise until the tension is fully released from the parking brake cables.

   Up to 50 cycles may be required until the parking brake cable tension is fully released.
5. Install the protective plug to the EPB module.
6. Install the underbody rear air rear deflector. Refer to *Underbody Rear Air Rear Deflector Replacement (Rear) on page 3-129* or *Underbody Rear Air Rear Deflector Replacement (Front) on page 3-130*.

Parking Brake Cable Adjuster Enabling

The park brake cable tension is controlled by the electronic park brake (EPB) module. Cable tension needs to be set and the EPB module needs to be calibrated following the cable tension disabling procedure. Perform one of the following two methods to fully restore cable tension.

Electronic Parking Brake Cable Tensioning

With Scan Tool - Preferred Method

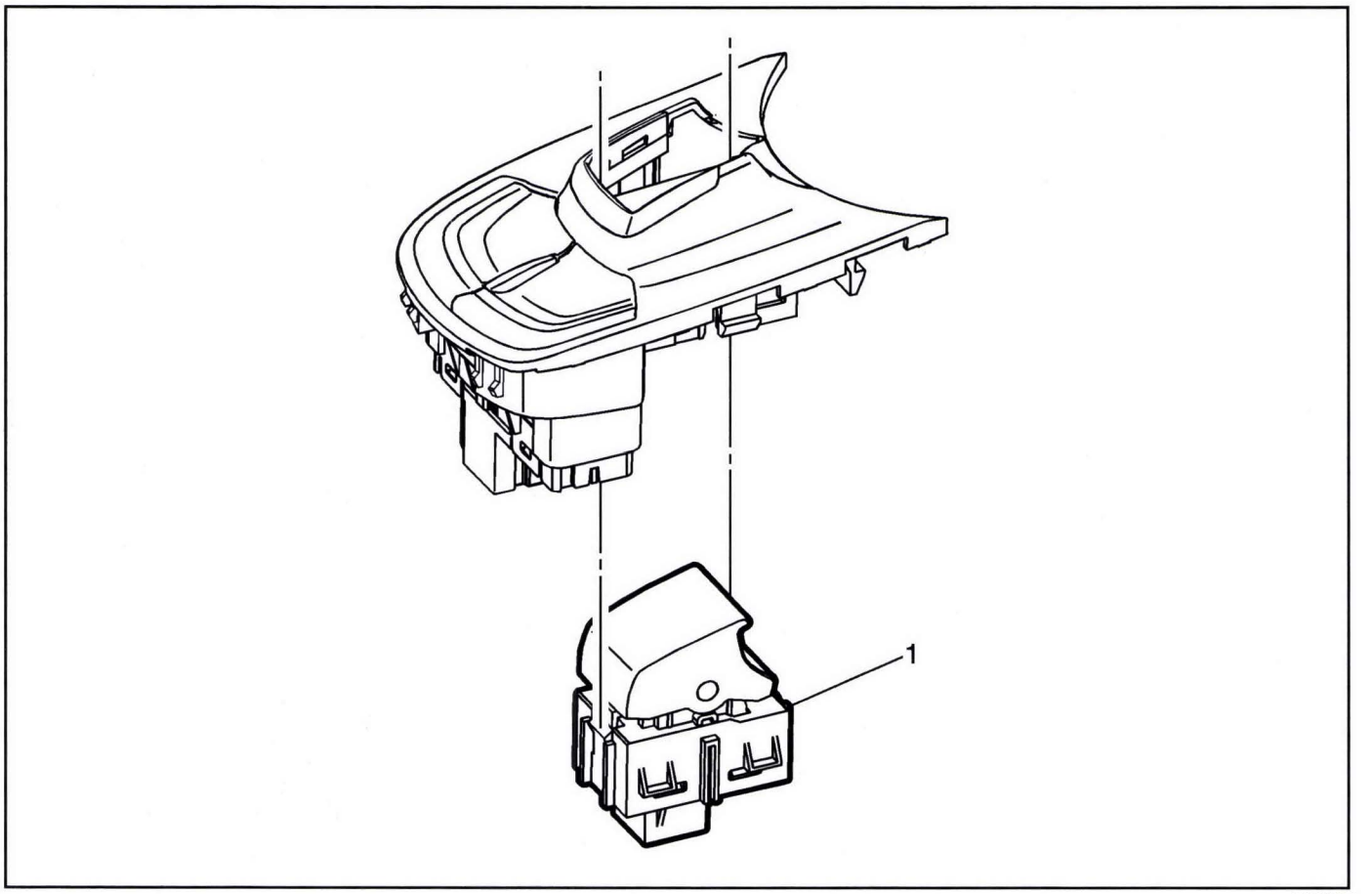
1. Block the drive wheels.
2. Install a scan tool to the vehicle.
3. Place the power button in Service Only Mode.
4. Select Configuration/Reset Functions from the electronic parking brake control module menu.
5. Perform the Parking Brake Calibration procedure.

Without Scan Tool - Optional Method

1. Block the drive wheels.
2. Place the power button in Service Only Mode.
3. Apply the brake pedal.

4. Place the transmission in PARK.
5. Momentarily lift then release the EPB switch to apply the EPB.
6. Momentarily press down then release the EPB switch to release the EPB.
7. Repeat step 5 and 6 to cycle the EPB on then off an additional 4 times.
8. The EPB module will be calibrated and proper tension will be applied to the parking brake cables.

Parking Brake Actuator Switch Replacement



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Parking Brake Actuator Switch Replacement

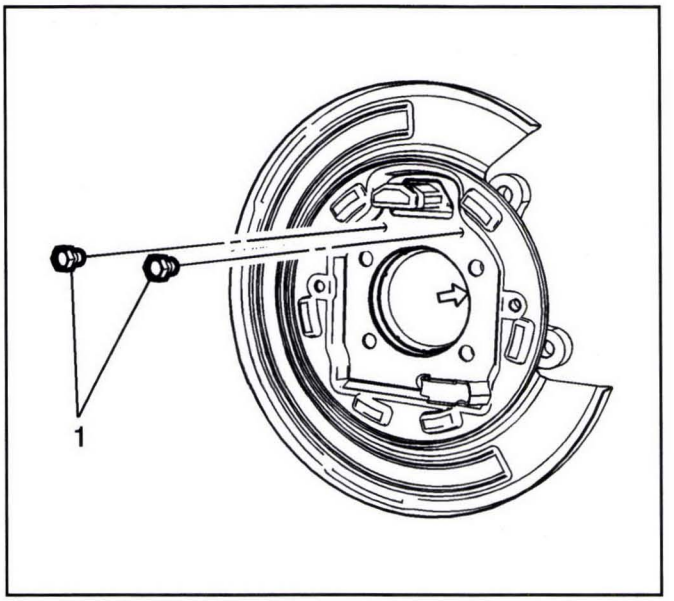
Callout	Component Name
Preliminary Procedure Remove the vehicle stability control system switch. Refer to *Vehicle Stability Control System Switch Replacement on page 5-90*.	
1	Parking Brake Actuator Switch **Procedure** Using the appropriate tool depress the tabs on the switch and gently remove.

Rear Parking Brake Anchor Backing Plate Replacement

Removal Procedure

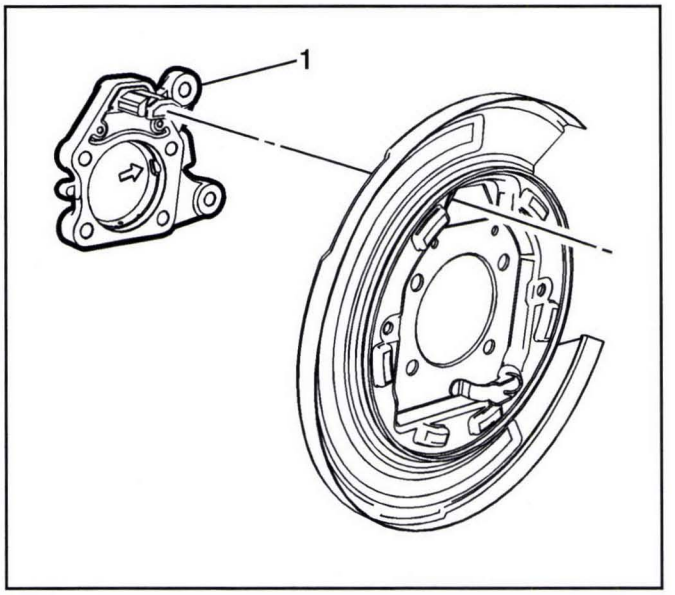
Warning: Refer to Brake Dust Warning on page 0-4.

1. Place the transmission in PARK.
2. Disable the parking brake cable adjuster. Refer to *Parking Brake Cable Adjuster Disabling on page 5-264*.
3. Place the power button in the OFF position.
4. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
5. Remove the parking brake shoe and cable assembly. Refer to *Parking Brake Shoe Replacement on page 5-249*.



3415719

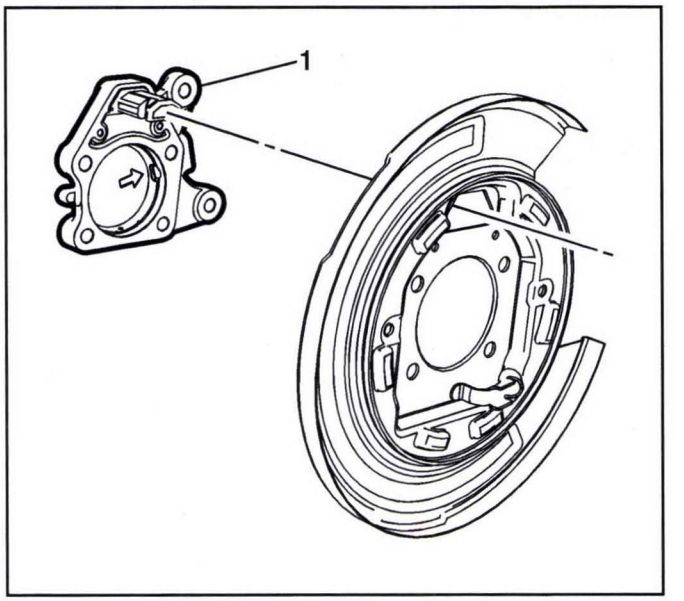
6. Remove the park brake backing plate bolts (1).



3415720

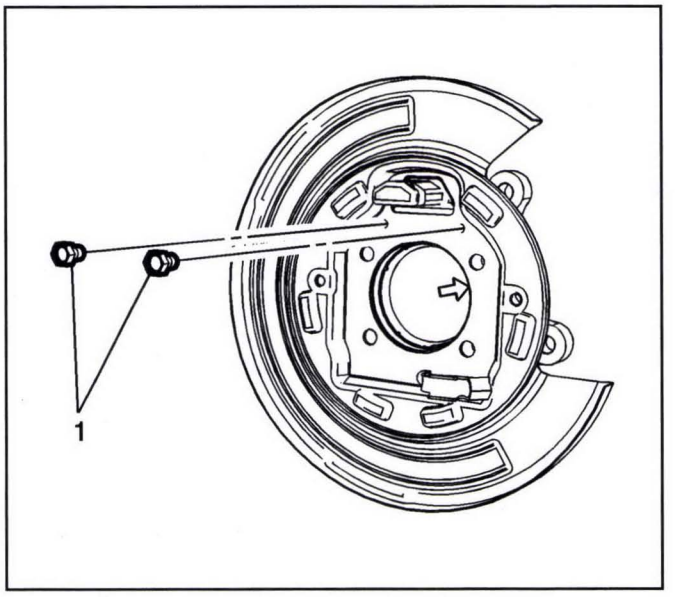
7. Remove the rear parking brake anchor plate (1) from the rear brake backing plate.

Installation Procedure



3415720

1. Install the rear parking brake anchor plate (1) to the rear brake backing plate.



3415719

Caution: Refer to *Fastener Caution on page 0-8*.

2. Install the park brake backing plate bolts (1) and tighten to **5 N•m (44 lb in)**.
3. Install the parking brake shoe and cable assembly. Refer to *Parking Brake Shoe Replacement on page 5-249*.
4. Adjust the parking brake. Refer to *Parking Brake Adjustment on page 5-267*.
5. Enable the parking brake cable adjuster. Refer to *Parking Brake Cable Adjuster Enabling on page 5-264*.

Parking Brake Adjustment

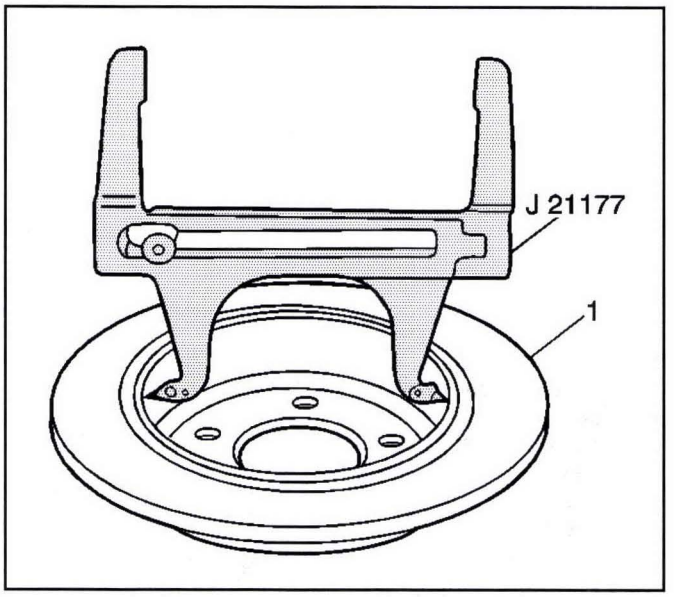
Special Tools

CH-21177-A Drum To Brake Shoe Clearance Gauge

For equivalent regional tools, refer to *Special Tools on page 5-269*.

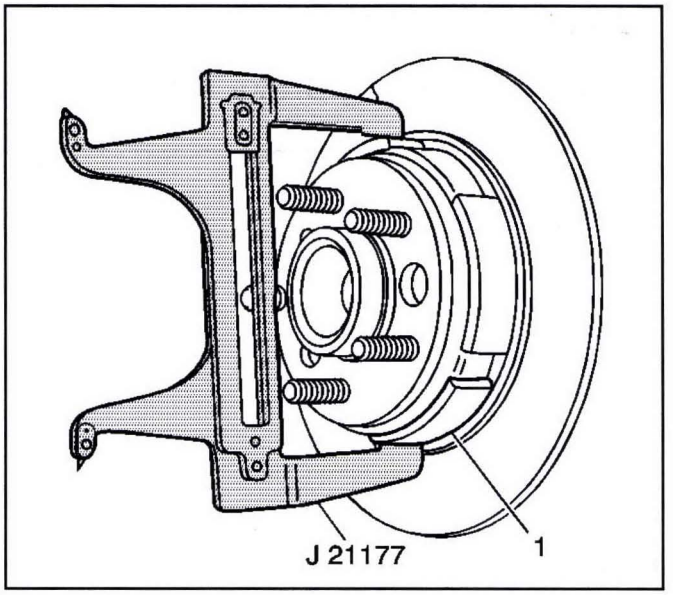
1. Adjustments to the parking brake shoes are not necessary after replacing the electronic parking brake control module or parking brake cable.
2. Disable the parking brake cable adjuster. Refer to *Parking Brake Cable Adjuster Disabling on page 5-264*.
3. Verify that the parking brake releases completely.
4. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-27*.
5. Remove the rear tire and wheel assemblies. Refer to *Tire and Wheel Removal and Installation on page 15-51*.

   Note: Do not operate the electronic parking brake with the rear disc brake rotor(s) removed.
6. Remove the rear brake rotors. Refer to *Rear Brake Rotor Replacement on page 5-124*.



177200

7. Set the *CH-21177-A* drum to brake shoe clearance gauge inside of the parking brake drum at the widest point.
   - Place the contacts of the tool at the widest point of the parking brake drum portion of the rotor (1).
   - Tighten the set screw on the tool to ensure the proper measurement when removing the tool from the drum.



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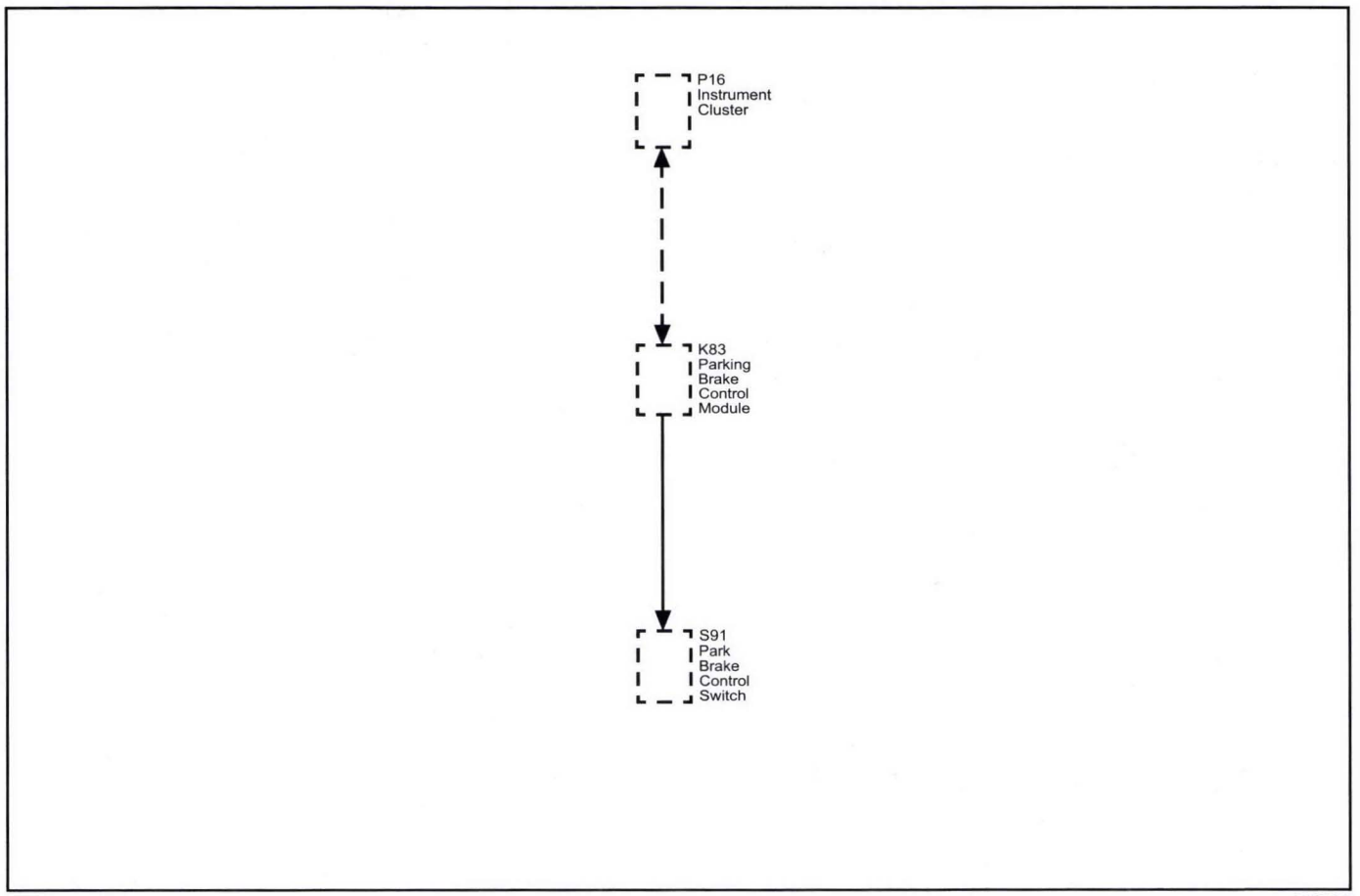
8. Position the *CH-21177-A* drum to brake shoe clearance gauge over the parking brake shoes (1) at the widest point.
9. Turn the parking brake shoe adjuster until the parking brake shoes just contact the *CH-21177-A* drum to brake shoe clearance gauge.
10. Repeat steps 7 through 9 for the opposite side.
11. Install the rear brake rotors. Refer to *Rear Brake Rotor Replacement on page 5-124*.
12. Install the rear tire and wheel. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
13. Lower the vehicle to curb height.
14. Enable the parking brake cable adjuster. Refer to *Parking Brake Cable Adjuster Enabling on page 5-264*.

    Note: If the rear wheels rotate during the following test, readjust the parking brake shoes.
15. Apply the parking brake. Inspect the rotation of the rear wheels:
    - The wheels should not rotate forward.
    - The wheels should not rotate rearward.
16. Release the parking brake. Verify that the wheels rotate freely.
17. Lower the vehicle.

Description and Operation

Electronic Parking Brake Control Module Description



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Vehicles with the electric parking brake have a switch in the center console, which takes the place of the manual parking brake system, the foot pedal and release handle. In case of insufficient electrical power, the electric parking brake cannot be applied or released.

Electric Parking Brake Control Module

The parking brake control module has an internal motor, apply actuator, release actuator, and temperature sensor. The parking brake control module also contains the logic for applying and releasing the parking brake when commanded by the park brake control switch. When the parking brake control module receives a signal from the switch the internal circuit board temperature is checked to verify it is within operating range before the control module performs the requested operation.

The electric parking brake module receives hard wired signals from the apply/release switch and communication enable. The electric parking brake module receives wheel speed sensor signals, engine torque, gear information, brake pedal signal, and etc. through GM-LAN.

Electric Parking Brake Apply

The electric parking brake can be applied any time the vehicle is stopped or in motion. The electric parking brake is applied by momentarily lifting up on the park brake control switch. The red park brake light will momentarily flash while the parking brake is being applied. Once fully applied, the red park brake light will turn on. If the electric parking brake is applied while the vehicle is in motion, a chime will sound, and the message "Release Park Brake Switch" will be displayed.

If the red park brake light is flashing, the electric parking brake is only partially applied or released, or there is a problem with the electric parking brake. The message "Service Park Brake" will be displayed.

Electric Parking Brake Release

To release the electric parking brake, turn the ignition switch to the ON or RUN position, apply and hold the brake pedal, and push down momentarily on the park brake control switch. When the electric parking brake is released the red park brake light turns off.

The electric parking brake can be used to prevent roll back for vehicles with a manual transmission taking off on a hill. In a situation where no roll back is desired, an applied electric parking brake will allow both feet to be used for the clutch and accelerator pedals in preparation for starting the vehicle moving in the intended direction. In this situation, perform the normal clutch and accelerator actions required to begin moving the vehicle. There is no need to push the switch to release the electric parking brake. To disable this

feature lift and hold the park brake control switch while the vehicle is in motion, this will keep the electric parking brake applied.

Manual Parking Brake Cable Tension Release

If the park brake cable tension cannot be released under normal mode of operation, it can be released manually. The manual release capability will make it possible for the driver to transfer the vehicle into a movable state in the case of a failure of the electric parking brake system. The procedure can be found in the Repair Instructions, Parking Brake Cable Adjuster Disabling procedure.

Park Brake System Description and Operation

System Component Description

The park brake system consists of the following:

Electronic Parking Brake Control Module: Electronically transfers park brake system apply input force to park brake cable system. Refer to *Electronic Parking Brake Control Module Description on page 5-268*.

Park Brake Cables: Transfers input force received from the electronic parking brake control module, through park brake cable equalizer, to park brake apply lever.

Park Brake Cable Equalizer: Evenly distributes input force to both the left and right park brake units.

Park Brake Actuator/Adjuster: Uses multiplied input force from apply lever via the cables to expand park brake shoe toward the friction surface of the drum-in-hat portion of the rear brake rotor.

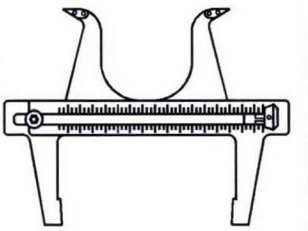
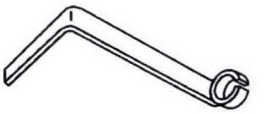
Threaded park brake actuators/adjusters are also used to control clearance between the park brake shoe and the friction surface of the drum-in-hat portion of the rear brake rotor.

Park Brake Shoe (Rear Disc, Drum-In-Hat System): Applies mechanical output force from park brake actuator/adjuster to friction surface of the drum-in-hat portion of the rear brake rotor.

System Operation

Park brake apply input force is generated by the electronic parking brake control module, transferred and evenly distributed, through the park brake cables and the park brake cable equalizer, to the left and right park brake apply levers. The park brake apply levers multiply and transfer the apply input force to the park brake actuators/adjusters which expand the park brake shoe toward the friction surface of the drum-in-hat portion of the rear brake rotor in order to prevent the rotation of the rear tire and wheel assemblies. The electronic parking brake control module releases an applied park brake system when signalled by the parking brake actuator switch.

Special Tools and Equipment

Illustration	Tool Number/ Description
 9123	CH 21177 J 21177 Drum To Brake Shoe Clearance Gauge
 157368	CH 37043 J 37043 Parking Brake Cable Release Tool

BLANK

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A11	*Radio Scan Tool Information on page 6-80*	*Radio/Navigation System Schematics on page 8-4*	*Radio Replacement on page 8-57*	*Radio Programming and Setup on page 6-16*
K1	14 Volt Power Module *Accessory DC Power Control Module Scan Tool Information on page 6-20*	*Starting and Charging Schematics on page 9-8*	*Accessory DC Power Control Module Replacement on page 9-189*	14 Volt Power Module *Accessory DC Power Control Module Programming and Setup on page 6-5*
K9	*Body Control Module Scan Tool Information on page 6-22*	*Body Control System Schematics on page 11-14*	*Body Control Module Replacement on page 11-234*	*Body Control Module Programming and Setup on page 6-6*
K16	*Battery Energy Control Module Scan Tool Information on page 6-45*	*Hybrid/EV Energy Storage Schematics on page 9-348*	*Battery Energy Control Module Replacement on page 9-451*	*Battery Energy Control Module Programming and Setup on page 6-6*
K17	*Electronic Brake Control Module Scan Tool Information on page 6-36*	*Antilock Brake System Schematics on page 5-6*	*Electronic Brake Control Module Replacement on page 5-75*	*Electronic Brake Control Module Programming and Setup on page 6-9*
K20	*K20 Engine Control Module: Scan Tool Information on page 6-40*	*Hybrid/EV Controls Schematics on page 9-54*	*Engine Control Module Replacement on page 9-171*	*K20 Engine Control Module: Programming and Setup on page 6-10*
K33	HVAC Control Module	*HVAC Schematics on page 10-81*	*Heater and Air Conditioning Remote Control Replacement on page 10-134*	*HVAC System Control Module Programming and Setup on page 6-11*
K36	*Inflatable Restraint Sensing and Diagnostic Module Scan Tool Information on page 6-74*	*SIR Schematics on page 12-101*	*Airbag Sensing and Diagnostic Module Replacement on page 12-155*	*Inflatable Restraint Sensing and Diagnostic Module Programming and Setup on page 6-13*
K41	*Object Alarm Module Scan Tool Information on page 6-79*	*Object Detection Schematics on page 12-36*	*Parking Assist Control Module Replacement on page 12-50*	*Object Alarm Module Programming and Setup on page 6-15*
K43	*Power Steering Control Module Scan Tool Information on page 6-79*	*Power Steering Schematics on page 14-4*	*Electronic Power Steering Motor Control Module Replacement on page 14-17*	*Power Steering Control Module Programming and Setup on page 6-15*
K73	*Telematics Communication Interface Control Module Scan Tool Information on page 6-81*	*OnStar/Telematics Schematics on page 8-6*	*Communication Interface Module Replacement on page 8-55*	*Telematics Communication Interface Control Module Programming and Setup on page 6-18*
K77	Remote Control Door Lock Receiver *Keyless Entry Control Module Scan Tool Information on page 6-78*	*Remote Function Schematics on page 12-55*	*Remote Control Door Lock Receiver Replacement on page 12-78*	*Remote Control Door Lock Receiver Programming and Setup on page 6-18*

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Code	Control Module/Scan Tool Information	Schematic	Repair Instruction	Programming and Setup
K83	*Electronic Parking Brake Control Module Scan Tool Information on page 6-39*	*Park Brake System Schematics on page 5-221*	*Electronic Parking Brake Control Module Replacement on page 5-247*	*Electronic Parking Brake Control Module Programming and Setup on page 6-9*
K84	*Keyless Entry Control Module Scan Tool Information on page 6-78*	*Remote Function Schematics on page 12-55*	*Keyless Entry Control Module Replacement on page 12-76*	*Keyless Entry Control Module Programming and Setup on page 6-14*
K85	*Inflatable Restraint Passenger Presence System Scan Tool Information on page 6-73*	*SIR Schematics on page 12-101*	*Airbag Front Passenger Presence Module Replacement on page 12-162*	*Passenger Presence System Programming and Setup on page 6-15*
K89	Immobilizer Control Module	*Immobilizer Schematics on page 12-4*	*Theft Deterrent Module Replacement (With BTM) on page 12-26*	*Immobilizer Control Module Programming and Setup on page 6-13*
K112	Hybrid/EV Battery Interface Control Module	*Hybrid/EV Energy Storage Schematics on page 9-348*	*High Voltage Battery Interface Control Module Replacement on page 9-512*	*Hybrid Battery Interface Control Module Programming and Setup on page 6-11*
K114B	*Hybrid Powertrain Control Module 2 Scan Tool Information on page 6-61*	*Hybrid/EV Cooling Schematics on page 9-201* or *Hybrid/EV Energy Storage Schematics on page 9-348*	*Hybrid Powertrain Control Module 2 Replacement on page 11-236*	*Hybrid Powertrain Control Module 2 Programming and Setup on page 6-12*
P16	*Instrument Cluster Scan Tool Information on page 6-77*	*Instrument Cluster Schematics on page 8-77*	*Instrument Cluster Replacement on page 8-95*	*Instrument Cluster Programming and Setup on page 6-14*
T6	Power Inverter Module • *Automatic Transmission Auxiliary Fluid Pump Control Module Scan Tool Information on page 6-21* • *Hybrid Powertrain Control Module Scan Tool Information on page 6-54* • *Motor Control Module 1 Scan Tool Information on page 6-78*	*Hybrid/EV Controls Schematics on page 9-54*	*Drive Motor Generator Power Inverter Module Replacement on page 9-184*	*Drive Motor Generator Power Inverter Module Programming and Setup on page 6-8*
T18/K57	Battery Charger Control Module	*Plug-In Charging Schematics on page 9-553*	*Drive Motor Battery Charger Replacement on page 9-649*	*Battery Charger Programming and Setup on page 6-5*

Repair Instructions

Accessory DC Power Control Module Programming and Setup

This device requires no programming or setup.

Air Conditioning Compressor Control Module Programming and Setup

Note:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the *EL-49642* SPS programming support tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct power mode.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/ Maintenance (I/M) system status indicators to NO.

Replace and Program ACCM or Reprogram ACCM

To program a replacement or an existing Air Conditioning Control Module (ACCM), perform the following procedure:

1. Install *EL-49642* SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Air Conditioning Control Module (ACCM) Programming and follow the on-screen instructions.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the vehicle OFF for at least one minute.
4. Vehicle in Service Mode, attempt to reprogram the ECU. The ECU should program.
   ⇒ If the ECU still cannot be programmed, replace the ECU.

Battery Charger Programming and Setup

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to *Special Tools on page 6-19*.

Note:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the *EL-49642* SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct power mode.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/ Maintenance (I/M) system status indicators to NO.

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Install *EL-49642* SPS programming support tool.
2. Connect the drive motor battery charger cable.
3. Access the Service Programming System (SPS) and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select Battery Charger – Programming and follow the on-screen instructions.
5. At the end of programming, choose the “Clear All DTCs” function on the SPS screen.
6. Vehicle in Service Mode.

7. With a scan tool, select Hybrid/EV Powertrain Control Module 2 Configuration/Reset Functions. Perform the Learn Functions - Hybrid/EV Battery Pack Charging Adaptive Learn Reset and follow the on-screen instructions.
8. Fully charge the battery to set the initial vehicle range. This range will adjust as the battery is charged and discharged through normal operation.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the vehicle OFF for at least one minute.
4. Vehicle in Service Mode, attempt to reprogram the ECU. The ECU should program.
   ⇒ If the ECU still cannot be programmed, replace the ECU.

Battery Energy Control Module Programming and Setup

Note:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the *EL-49642* SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/ Maintenance (I/M) system status indicators to NO.

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Install *EL-49642* SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Battery Energy Control Module - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the Vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the Vehicle OFF for at least one minute.
4. Turn the Vehicle in Service Mode and attempt to reprogram the ECU. The ECU should program.
   ⇒ If the ECU still cannot be programmed, replace the ECU.

Body Control Module Programming and Setup

Note:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the *EL-49642* SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.

- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/ Maintenance (I/M) system status indicators to NO.

Reference Information

Special Tools

- *EL-49642* SPS Programming Support Tool
- *EL-46079* Tire Pressure Monitor Diagnostic Tool or *EL-50448* Tire Pressure Monitor Sensor Activation Tool

For equivalent regional tools, refer to *Special Tools on page 6-19*.

Replace and Program Control Module

To program a replacement K9 Body Control Module (BCM), perform the following procedure:

1. Install *EL-49642* SPS programming support tool.

   Note: Make sure the vehicle ignition switch state is in appropriate position for the following step.

   - For Key Ignition System, begin with the ignition in the RUN position.
   - For Push Button Start System, begin with the vehicle in vehicle OFF power mode. The Service Programming System will power mode the vehicle.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K9 Body Control Module - Programming and follow the on-screen instructions.
4. Perform the following for the appropriate ignition type prior to proceeding with the next step:
   - Key Ignition System: Key in the ignition and any additional keys must be away from the vehicle at least 3 m.
   - Push Button Start System: Keyless entry transmitter must be in the programming pocket. Refer to the owner manual for the exact pocket location. All additional transmitters must be away from the vehicle at least 3 m.

   Note: The following programming step may take between 10–12 min and progress will appear to have stopped during this process. This is a normal security timer response and a restart should not be performed. If the DTC B389A set immediately after programming a replacement BCM, the Immobilizer Learn procedure was not properly completed. The Immobilizer Learn procedure needs to be performed again.
5. On the SPS Supported Controllers screen, select IMMO Immobilizer Learn - Setup. On the next screen, select Body Control Module IMMO Learn with Existing Transponder or Remote Key and follow the on-screen instructions. When Immobilizer Learn is complete, press the Unlock button on the keyless entry transmitter to allow the keyless entry transmitter to exit the Immobilizer Learn mode.

   Note: When performing the Tire Pressure Monitor Sensor Learn during BCM setup, the *EL-46079* tire pressure monitor diagnostic tool must be used to activate each tire pressure sensor for vehicles with UJM.

   - For Key Ignition System, begin with the ignition in the RUN position.
   - For Push Button Start System, begin with the vehicle in vehicle ON power mode.
6. On the SPS Supported Controllers screen, select K9 Body Control Module - Setup (or K9 Body Control Module - Configuration & Setup) and follow the on-screen instructions.
7. Check the driver information center display for additional messages regarding further calibration instructions. If there are no additional driver information center instructions present, programming is complete.
8. At the end of programming, choose the "Clear DTCs" function on the SPS screen.
9. If ABS, Traction Control and/or Stabilitrak indicators are ON and DTC C0161 is set in the K17 Electronic Brake Control Module after performing BCM programming and setup, do the following:

   9.1. Disconnect the scan tool from the X84 Data Link Connector.

   9.2. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from the vehicle. It may take up to 2 min to power down.

   9.3. Ignition ON, verify DTC C0161 is in history. If not, repeat the above step to make sure the vehicle is in sleep mode.

   9.4. Use the scan tool to clear the DTCs.

Reprogram Control Module

To program an existing K9 Body Control Module, perform the following procedure:

1. Install *EL-49642* SPS programming support tool.

   Note: Make sure the vehicle ignition switch state is in appropriate position for the following step.

   - For Key Ignition System, begin with the ignition in the RUN position.
   - For Push Button Start System, begin with the vehicle in vehicle ON power mode.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K9 Body Control Module - Programming and follow the on-screen instructions.

   Note: When performing the Tire Pressure Monitor Sensor Learn during BCM setup, the *EL-46079* tire pressure monitor diagnostic tool must be used to activate each tire pressure sensor for vehicles with UJM.
4. On the SPS Supported Controllers screen, select K9 Body Control Module - Setup (or K9 Body Control Module - Configuration & Setup) and follow the on-screen instructions.

5. Check the driver information center display for additional messages regarding further calibration instructions. If there are no additional driver information center instructions present, programming is complete.
6. At the end of programming, choose the "Clear DTCs" function on the SPS screen.
7. If ABS, Traction Control and/or Stabilitrak indicators are ON and DTC C0161 is set in the K17 Electronic Brake Control Module after performing BCM programming and setup, do the following:
   7.1. Disconnect the scan tool from the X84 Data Link Connector.
   7.2. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from the vehicle. It may take up to 2 min to power down.
   7.3. Ignition ON, verify DTC C0161 is in history. If not, repeat the above step to make sure the vehicle is in sleep mode.
   7.4. Use the scan tool to clear the DTCs.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.

⇒ **If the control module cannot be reprogrammed**

   2.1. Ignition OFF for one minute, ignition ON.
   2.2. Verify the control module can be reprogrammed.
   ⇒ If the control module cannot be reprogrammed, replace the control module.
   ⇓ If the control module can be reprogrammed.
   2.3. All OK.

⇓ **If the control module can be reprogrammed**

3. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for Control Module replacement, programming and setup

Drive Motor Generator Power Inverter Module Programming and Setup

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to *Special Tools on page 6-19*.

Note:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the *EL-49642* SPS programming support tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/ Maintenance (I/M) system status indicators to NO.

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Install *EL-49642* SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Power Inverter Module – Programming and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select Immobilizer Learn – Setup and follow the on-screen instructions.
5. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the vehicle OFF for at least one minute.
4. Turn the vehicle ON and attempt to reprogram the ECU. The ECU should program.
   ⇒ If the ECU still cannot be programmed, replace the ECU.

Electronic Brake Control Module Programming and Setup

Note:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the *EL-49642* SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/ Maintenance (I/M) system status indicators to NO.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to *Special Tools on page 6-19*.

Replace and Program Control Module or Reprogram Control Module

To program a replacement or an existing control module, perform the following procedure:

1. Install *EL-49642* SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K17 Electronic Brake Control Module-Programming and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select K17 Electronic Brake Control Module-Setup and Configuration while following the on-screen instructions.
5. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Vehicle ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.

⇒ **If the control module cannot be reprogrammed**

2.1. Vehicle OFF for one minute, ignition ON.

2.2. Verify the control module can be reprogrammed.

⇒ If the control module cannot be reprogrammed, replace the control module.

⇓ If the control module can be reprogrammed.

2.3. All OK.

⇓ **If the control module can be reprogrammed**

3. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for Control Module replacement, programming and setup

Electronic Parking Brake Control Module Programming and Setup

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to *Special Tools on page 6-19*.

Note:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the *EL-49642* SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.

- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/ Maintenance (I/M) system status indicators to NO.

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Install *EL-49642* SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K83 Park Brake Control Module – Programming and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select K83 Park Brake Control Module – Setup (OR K83 Park Brake Control Module – Configuration and Setup) and follow the on-screen instructions.
5. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.
6. With a scan tool, perform the Parking Brake Cable Adjuster Enabling procedure. Refer to *Parking Brake Cable Adjuster Enabling on page 5-264*.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.

⇒ **If the control module cannot be reprogrammed**

2.1. Ignition OFF for one minute, ignition ON.

2.2. Verify the control module can be reprogrammed.

⇒ If the control module cannot be reprogrammed, replace the control module.

⇓ If the control module can be reprogrammed.

2.3. All OK.

⇓ **If the control module can be reprogrammed**

3. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for park brake control module replacement, programming and setup.

K20 Engine Control Module: Programming and Setup

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to *Special Tools on page 6-19*.

Note:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the *EL-49642* SPS programming support tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct power mode.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/ Maintenance (I/M) system status indicators to NO.

Replace and Program ECM or Reprogram ECM

To program a replacement or an existing ECM, perform the following procedure:

1. Install *EL-49642* SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select ECM Programming and follow the on-screen instructions.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the vehicle OFF for at least one minute.
4. Vehicle in Service Mode, attempt to reprogram the ECU. The ECU should program.

⇒ If the ECU still cannot be programmed, replace the ECU.

HVAC System Control Module Programming and Setup

Note:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the *EL-49642* SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/ Maintenance (I/M) system status indicators to NO.

Diagnostic Aids

Use the scan tool to determine the status of the afterblow feature prior to programming. When the module is programmed, the afterblow feature is set to disabled by default.

If the afterblow feature was previously enabled, or is desired, use the scan tool HVAC Control Module Configuration Functions to enable the afterblow feature.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to *Special Tools on page 6-19*.

Replace and Program Control Module or Reprogram Control Module

To program a replacement or an existing control module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select K33 HVAC Control Module - Programming and follow the on-screen instructions.
3. At the end of programming, select the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC, and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.

⇒ **If the control module cannot be reprogrammed**

2.1. Ignition OFF for one minute, ignition ON.

2.2. Verify the control module can be reprogrammed.

⇒ If the control module cannot be reprogrammed, replace the control module.

⇓ If the control module can be reprogrammed.

2.3. All OK.

⇓ **If the control module can be reprogrammed**

3. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for control module replacement, programming and setup.

Hybrid Battery Interface Control Module Programming and Setup

Note:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the *EL-49642* SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/ Maintenance (I/M) system status indicators to NO.

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Install *EL-49642* SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Battery Energy Control Module - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the Vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the Vehicle OFF for at least one minute.
4. Turn the Vehicle in Service Mode and attempt to reprogram the ECU. The ECU should program.
   ⇒ If the ECU still cannot be programmed, replace the ECU.

Hybrid Powertrain Control Module 2 Programming and Setup

Note:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the *EL-49642* SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/ Maintenance (I/M) system status indicators to NO.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to *Special Tools on page 6-19*.

Replace and Program Control Module

To program a replacement control module, perform the following procedure:

1. Install *EL-49642* SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Hybrid Powertrain Control Module 2 - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs"
5. With a scan tool, perform the *Hybrid/EV Battery Pack Capacity Learn on page 9-541* and follow the on-screen instructions.
6. With a scan tool, select Hybrid/EV Powertrain Control Module 2 Configuration/Reset Functions. Perform the Learn Functions - Hybrid/EV Battery Pack Charging Adaptive Learn Reset and follow the on-screen instructions.
7. With a scan tool, perform the *Hybrid/EV Battery Pack Coolant Control Valve Learn on page 9-343* and follow the on-screen instructions.
8. With a scan tool, perform the *Clear Secured High Voltage DTCs on page 9-539* and follow the on-screen instructions.
9. With a scan tool, Clear All DTCs.

Reprogram Control Module

To program an existing control module, perform the following procedure:

1. Install *EL-49642* SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Hybrid Powertrain Control Module 2 - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs"

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.

2. Verify the control module can be reprogrammed.

⇒ **If the control module cannot be reprogrammed**

2.1. Ignition OFF for one minute, ignition ON.

2.2. Verify the control module can be reprogrammed.

⇒ If the control module cannot be reprogrammed, replace the control module.

⇓ If the control module can be reprogrammed.

2.3. All OK.

⇓ **If the control module can be reprogrammed**

3. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for hybrid/EV powertrain control module 2 replacement, programming and setup.

Immobilizer Control Module Programming and Setup

Replace and Program ECU or Reprogram ECU

This ECU does not require SPS programming or any setup procedures.

Inflatable Restraint Sensing and Diagnostic Module Programming and Setup

Note:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the *EL-49642* SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/ Maintenance (I/M) system status indicators to NO.
- The air bag indicator light may remain ON after the body control module (BCM), or Inflatable Restraint Sensing and Diagnostic Moduleis replaced, and during the programming procedure for the BCM until after the procedure is completed. When installing a new Inflatable Restraint Sensing and Diagnostic Module, there may be several DTCs set prior to programming. Once programmed, these DTCs should be in history and can be cleared.
- Failure to complete the following Setup procedure may cause DTC B1001 to be set in the Inflatable Restraint Sensing and Diagnostic Module.

Replace and Program Control Module or Reprogram Control Module

To program a replacement or an existing control module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select K36 Inflatable Restraint Sensing and Diagnostic Module - Programming and Setup and follow the on-screen instructions.
3. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.

⇒ **If the control module cannot be reprogrammed**

2.1. Ignition OFF for one minute, ignition ON.

2.2. Verify the control module can be reprogrammed.

⇒ If the control module cannot be reprogrammed, replace the control module.

⇓ If the control module can be reprogrammed.

2.3. All OK.

⇓ **If the control module can be reprogrammed**

3. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for Control Module replacement, programming and setup

Instrument Cluster Programming and Setup

Note:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the *EL-49642* SPS programming support tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct power mode.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/ Maintenance (I/M) system status indicators to NO.

Replace and Program ECU or Reprogram ECU

Note: This procedure may require a USB flash drive. SPS will indicate if the flash drive is needed.

To program a replacement or an existing ECU, perform the following procedure:

1. Install *EL-49642* SPS programming support tool.
2. Connect the USB flash drive to the SPS terminal/PC.
3. Access the Service Programming System (SPS) and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select Instrument Cluster - Step 1 Prepare Control Module for Programming and follow the on-screen instructions. If the USB flash drive is needed perform steps 4.1 and 4.2. If the USB is not needed continue on to step 5.

   Note: SPS will indicate when it is safe to remove the flash drive from the SPS terminal.

   4.1. Physically remove the cluster while leaving the connector plugged in to access the USB port on the back of the cluster.

   4.2. Using cable EL-50334-2 from special tool kit *EL-50334-50* infotainment adapter kit, connect the USB flash drive to the instrument cluster.
5. On the SPS Supported Controllers screen, select Instrument Cluster - Step 2 Programming and follow the on-screen instructions.

   Note: If the USB flash drive was required, the instrument cluster will automatically copy files from the flash drive. The SPS screen will indicate 100% completion but SPS will not say programming successful yet, the instrument cluster may still be programming. The instrument cluster screen will display a progression indicator while it is copying files from the USB drive. Once all files are programmed, SPS will then indicate programming successful.
6. On the SPS Supported Controllers screen, select Instrument Cluster - Step 3 Setup and follow the on-screen instructions.
7. On the SPS Supported Controllers screen, select Instrument Cluster - Step 4 Configuration and follow the on-screen instructions.
8. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the vehicle OFF for at least one minute.
4. Vehicle in Service Mode, attempt to reprogram the ECU. The ECU should program.

   ⇒ If the ECU still cannot be programmed, replace the ECU.

Keyless Entry Control Module Programming and Setup

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to *Special Tools on page 6-19*.

Note:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the *EL-49642* SPS programming support tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.

- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/ Maintenance (I/M) system status indicators to NO.

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Install *EL-49642* SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Keyless Entry Control Module – Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the vehicle OFF for at least one minute.
4. Turn the vehicle to Service Mode and attempt to reprogram the ECU. The ECU should program.
   ⇒ If the ECU still cannot be programmed, replace the ECU.

Object Alarm Module Programming and Setup

The K41R Rear Parking Assist Control Module requires no programming or setup.

Passenger Presence System Programming and Setup

When the passenger presence system is replaced or serviced, perform the rezeroing procedure for the passenger presence system. Refer to *Passenger Presence System Rezeroing on page 12-147* for the rezeroing procedure.

Power Steering Control Module Programming and Setup

Note:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the *EL-49642* SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct power mode/ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/ Maintenance (I/M) system status indicators to NO.

Diagnostic Aids

The internal steering wheel angle sensor does not require a centering often. Centering of the internal steering wheel angle sensor might be required after certain service procedures are performed. Some of these procedures are as follows:

- Power Steering Control module replacement
- Steering column replacement
- Collision or other physical damage to steering or suspension components

Certain steering symptoms can be corrected by performing the steering wheel angle sensor centering procedures such as:

- Poor, or uneven return to center
- Poor, or uneven on center feel

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to *Special Tools on page 6-19*.

Replace and Program Control Module or Reprogram Control Module

This control module does not require SPS programming or any setup procedures.

This control module does not require SPS programming but does require the following setup procedures after a new control module is installed:

To program a replacement or an existing control module, perform the following procedure:

1. Install *EL-49642* SPS Programming Support Tool.
2. Using the steering wheel, align and center the front wheels forward.
3. Apply the parking brake, and set the transmission in Park if equipped with an automatic transmission.
4. Vehicle in Service Mode.
5. Access the Service Programming System (SPS) and follow the on-screen instructions.
6. On the SPS Supported Controllers screen, select Power Steering Control Module - Programming and follow the on-screen instructions.
7. On the SPS Supported Controllers screen, select Steering Wheel Angle Sensor Centering - Configuration and follow the on-screen instructions.
8. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.
9. Vehicle OFF.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Vehicle in Service Mode, ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.

⇒ **If the control module cannot be reprogrammed**

2.1. Vehicle OFF for one minute, Vehicle in Service Mode.

2.2. Verify the control module can be reprogrammed.

⇒ If the control module cannot be reprogrammed, replace the control module.

⇓ If the control module can be reprogrammed.

2.3. All OK.

⇓ **If the control module can be reprogrammed**

3. All OK.

Repair Instructions

Perform the *Diagnostic Repair Verification on page 6-123* after completing the repair.

Control Module References on page 6-3 for Control Module replacement, programming and setup.

Radio Programming and Setup

Note:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the *EL-49642* SPS programming support tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/ Maintenance (I/M) system status indicators to NO.

Diagnostic Aids

- If programming of the control module is being performed at the direction of a bulletin or PI, follow the instructions provided in that document.
- During audio system programming you may be required to select multiple calibrations dependent upon vehicle equipment. Have the vehicle build/ RPO information available during the following procedure to ensure the correct calibrations are selected.
- Dependant upon vehicle equipment, the current software level of the module, or the release of updates, USB programming may not be required when replacing/reprogramming the control module. If USB files for the application are not available via SPS, or have not been received from General Motors in another manner of distribution, the USB update process will not need to be performed.
- The length of time for the USB programming to complete will vary depending on the number and size of the files in the update.
- All data will be erased from the USB device BEFORE the calibration is downloaded onto the device. To ensure important information is NOT erased, always verify that NO information is stored on the device BEFORE beginning the calibration download. If required, transfer important files to another storage device BEFORE beginning the calibration download.

- The XM satellite radio (if equipped) is integrated into the radio. If XM was activated in the previous radio, the replacement radio will require additional activation steps after programming to transfer customer subscription information.

Reference Information

Special Tools

- *EL-49642* SPS Programming Support Tool
- USB 2.0 flash drive with a minimum capacity of 4 GB.

For equivalent regional tools, refer to *Special Tools on page 6-19*.

Replace and Program Control Module

To program a replacement control module, perform the following procedure:

1. Install the *EL-49642* SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select A11 Radio – Programming, and follow the on-screen instructions.
4. When programming is complete, access the Service Programming System (SPS) and follow the on-screen instructions.
5. Connect a USB drive to the computer.

   Note: If using a pre-configured USB drive supplied by General Motors, proceed to step 8.
6. On the SPS Supported Controllers screen, select A11 Radio – USB File Transfer, and follow the on-screen instructions.

   Note:

   - If there are no files available for USB transfer via SPS, proceed to step 14.
   - All existing files on the USB drive will be erased when the new files are copied.
7. Upon completion of the file transfer, remove the USB drive from the computer.
8. Vehicle in Service Mode, radio ON.
9. Connect the USB drive to the USB port in the vehicle.
10. Using the radio controls, select the following: Config>Radio Settings>Software Versions Menu>Update Radio Software. Follow the infotainment display on-screen instructions and select Update when prompted. Programming will take several minutes.
11. When programming is complete, remove the USB device from the vehicle USB port.
12. Access the Service Programming System (SPS) and follow the on-screen instructions.
13. On the SPS Supported Controllers screen, select A11 Radio – Programming, and follow the on-screen instructions.
14. At the end of programming, choose the "Clear DTCs" function on the SPS screen.

Reprogram Control Module

To reprogram an existing control module, perform the following procedure:

1. Install the *EL-49642* SPS Programming Support Tool.
2. Connect a USB drive to the computer.

   Note: If using a pre-configured USB drive supplied by General Motors, proceed to step 6.
3. Access the Service Programming System (SPS) and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select A11 Radio – USB File Transfer, and follow the on-screen instructions.

   Note:

   - If there are no files available for USB transfer via SPS, proceed to step 11.
   - All existing files on the USB drive will be erased when the new files are copied.
5. Upon completion of the file transfer, remove the USB drive from the computer.
6. Vehicle in Service Mode, radio ON.
7. Connect the USB drive to the USB port in the vehicle.
8. Using the radio controls, select the following: Config>Radio Settings>Software Versions Menu>Update Radio Software. Follow the infotainment display on-screen instructions and select Update when prompted. Programming will take several minutes.
9. When programming is complete, remove the USB device from the vehicle USB port.
10. Access the Service Programming System (SPS) and follow the on-screen instructions.
11. On the SPS Supported Controllers screen, select A11 Radio – Programming, and follow the on-screen instructions.
12. At the end of programming, choose the "Clear DTCs" function on the SPS screen.

XM Activation (If Equipped)

Important: After replacement of an XM receiver, call XM radio to deactivate the receiver that has been removed from the vehicle.

1. Turn the radio ON, tune to the XM channel 0, and record the radio ID. The radio ID will be needed for activation of the receiver.
2. From the USA, Call XM radio at 1–800–556–3600 to activate the receiver. From Canada, call 1–877–438–9677.
3. Park the vehicle outside in an area with an unobstructed view of the southern sky.
4. Leave the vehicle outside with the ignition switch in the ACC position and the radio on for 30 minutes to activate XM service.
5. Once activated, the radio will receive the remaining XM channels.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Vehicle in Service Mode. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.

⇒ **If the control module cannot be reprogrammed**

2.1. Vehicle OFF for one minute, ignition ON.

2.2. Verify the control module can be reprogrammed.

⇒ If the control module cannot be reprogrammed, replace the control module.

⇓ If the control module can be reprogrammed.

2.3. All OK.

⇓ **If the control module can be reprogrammed**

3. All OK.

Remote Control Door Lock Receiver Programming and Setup

Diagnostic Aids

The remote control door lock receiver only functions as an antenna, receiving the signals sent by the keyless entry transmitter and forwarding them to the body control module (BCM). The keyless entry software is contained wholly within the BCM.

Replace and Program ECU or Reprogram ECU

This ECU does not require SPS programming or any setup procedures.

Telematics Communication Interface Control Module Programming and Setup

Note:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the *EL-49642* SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/ Maintenance (I/M) system status indicators to NO.

Diagnostic Aids

- Before beginning any programming first determine which Generation of the Telematics Communication Interface Control Module you are working with. One way to accomplish this is by using a scan tool. The Telematics Communication Interface Control Module Generation will be listed under the Selected Vehicle Configuration section, in addition the Generation (9 or 10) can be determined from the Module ID data table. Additional programming steps may be necessary depending on the generation of the module.
- It is critical to use the service replacement Communication Interface Module only in the vehicle for which it was ordered.
- Failure to perform the following procedures will result in a red LED, DTC(s) being set, and limited or incomplete OnStar® services.
- An OnStar® button press to the OnStar® call center is required to complete the procedure.
- To fully activate an OnStar® module, both the setup and activation request procedures must be completed on all vehicles with and without an active OnStar® subscription to insure the unit has been setup properly for the vehicle it has been installed into and also to update the OnStar® with the correct unit information.
- If the vehicle is equipped with RPO VV4 the Telematics Communication Interface Control Module WiFi Enable (Gen 10 only) Programming step must be performed AFTER the Programming and Service Activation step. Failure to complete this step in the proper sequence will result in WiFi being disabled.
- To initialize the Turn-by-Turn feature, the vehicle must first be driven In open sky condition at speeds greater than 10 mph (16 kph) or more for a minimum of 5 miles (8 km) , and perform at least 2 left and 2 right 90 degree turns coming to complete stops prior to each turn.
- On vehicles up fitted with TTY capabilities, it is necessary to perform a power cycle of the OnStar® Interface Module (OTIM), and toggle the TTY mode after completing the Communication Interface Module installation and setup procedures.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to *Special Tools on page 6-19*.

Replace and Program Control Module or Reprogram Control Module

To program a replacement or an existing control module, perform the following procedure:

1. Install *EL-49642* SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.

   Note:

   - Due to a change in SPS you must select 'Reprogram ECU', for Telematics Communication Interface Control Module Programming from the Selected Programming Process even if the unit is being replaced.
   - If 'Replace and Program ECU' is selected the Telematics Communication Interface Control Module will not be listed in the Supported Controllers screen. You must go back and select 'Reprogram ECU'.
3. In the SPS Supported Controllers screen, select Telematics Communication Interface Control Module Programming and Service Activation and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.
5. After Telematics Communication Interface Control Module Programming and Service Activation, if the vehicle is equipped with RPO VV4, on the Supported Controllers screen select Telematics Communication Interface Control Module WiFi Enable (Gen 10 only) Programming and follow the on-screen instructions.

   Note: The WiFi Enable step must be performed AFTER the Programming and Service Activation step, or WiFi will not function. If Programming and Service Activation step is performed after the WiFi Enable step, WiFi will be disabled.
6. Press the OnStar® Blue Button to call OnStar® and have the system activated. If the customer refused OnStar® services (terms and conditions) and the vehicle is equipped with RPO VV4 have the OnStar® consultant turn off the WiFi demo message that occurs after every ignition on event.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.

⇒ **If the control module cannot be reprogrammed**

2.1. Ignition OFF for one minute, ignition ON.

2.2. Verify the control module can be reprogrammed.

⇒ If the control module cannot be reprogrammed, replace the control module.

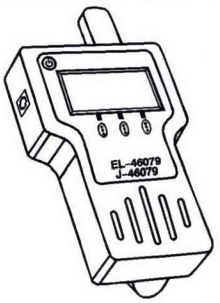
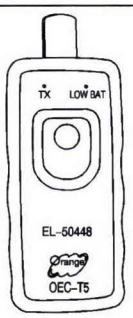
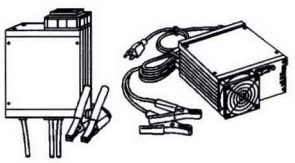
⇓ If the control module can be reprogrammed.

2.3. All OK.

⇓ **If the control module can be reprogrammed**

3. All OK.

Special Tools and Equipment

Illustration	Tool Number/ Description
 1493952	EL 46079 J 46079 Tire Pressure Monitor Diagnostic Tool
 2563769	EL 50448 Tire Pressure Monitor Sensor Activation Tool
 2223727	EL 49642 EL 50113 Europe– Use recommended equivalent workshop equipment SPS Programming Support Tool

Vehicle Diagnostic Information

Specifications

Accessory DC Power Control Module Scan Tool Information

The accessory DC power control module is also referred to as the 14 volt power module. The Accessory DC Power Control Module Scan Tool Data Parameters list contains hybrid controls-related parameters. The list is arranged in alphabetical order.

Use the 14V Power Control Module Scan Tool Data Parameters list only after the following is determined:

- The *Diagnostic System Check - Vehicle on page 6-91* is completed.
- No diagnostic trouble codes (DTCs)
- On-board diagnostics are functioning properly

The scan tool values from a properly running vehicle may be used for comparison with the vehicle you are diagnosing. The Accessory DC Power Control Module Scan Tool Data Parameters list represents values that would be seen on a normally running vehicle.

Note: A scan tool that displays faulty data should not be used. The scan tool concern should be reported to the manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.

Only the parameters listed below are referenced in this service manual for use in diagnosis. If all values are within the typical range described below, refer to *Symptoms - Hybrid Controls on page 9-167* for diagnosis.

14 Volt Power Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Vehicle ON/Closed Throttle/Park or Neutral/Accessories OFF, unless otherwise noted			
14V Power Module High Voltage Circuit Current	—	Varies	Indicates the high voltage circuit current as detected by the accessory dc power control module . The range is from −200.0 to +200.0 Amps. This is an indication of the power being consumed by the module.
14V Power Module Power Loss	—	Varies	The accessory DC power control module converts high voltage (300V) direct current (DC) to low voltage (12V) DC for accessory electrical operation and to charge the 12 volt battery. This parameter indicates the difference in power (power loss) between the input power and the output power of the Accessory Power Module. The power loss is determined based upon High Voltage current and voltage, Low Voltage current and voltage, and Intermediate Voltage current and voltage measurements from the accessory power module internal sensors.
14V Power Module Temperature Sensor 1	—	Varies	Indicates the temperature of the accessory DC power control module at temperature sensor 1.
14V Power Module Temperature Sensor 2	—	Varies	Indicates the temperature of the accessory DC power control module at temperature sensor 2.
Drive Motor 1 Inverter Status	—	Varies	Indicates the status of Drive Motor Generator 1 Motor Control Module.
Hybrid/EV Battery Pack Current	—	Varies	Indicates the hybrid battery current measured on the high voltage bus. A negative current value indicates a battery charge while a positive current value indicates a battery discharge.
Hybrid/EV Battery Pack State of Charge	—	Varies	Indicates the hybrid battery State Of Charge as calculated by the ECM.
Hybrid/EV Control Module High Voltage Circuit	—	Varies	Indicates the hybrid battery high voltage circuit status
Ignition 1 Signal	—	Varies	This parameter displays the voltage of the ignition feed circuit of the hybrid powertrain control module.

14 Volt Power Module Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Description
Low-Voltage Circuit Current	—	Varies	Indicates the amount of current supplied to the 12 volt battery as detected by the accessory DC power control module.
Low-Voltage Circuit Voltage	—	Varies	Indicates the actual voltage of the low voltage (14V) circuit as detected by the accessory DC power control module. The range is from 0–25.5 V.

Automatic Transmission Auxiliary Fluid Pump Control Module Scan Tool Information

The automatic transmission auxiliary fluid pump control module is a non-serviceable motor control module within the power inverter module, often referred to as the drive motor generator power inverter module assembly. The Automatic Transmission Auxiliary Fluid Pump Control Module Scan Tool Data Parameters list contains hybrid controls-related parameters. The list is arranged in alphabetical order.

Use the Automatic Transmission Auxiliary Fluid Pump Control Module Scan Tool Data Parameters list only after the following is determined:

- The *Diagnostic System Check - Vehicle on page 6-91* is completed.
- No diagnostic trouble codes (DTCs)
- On-board diagnostics are functioning properly

The scan tool values from a properly running vehicle may be used for comparison with the vehicle you are diagnosing. The Automatic Transmission Auxiliary Fluid Pump Control Module Scan Tool Data Parameters list represents values that would be seen on a normally running vehicle.

Note: A scan tool that displays faulty data should not be used. The scan tool concern should be reported to the manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.

Only the parameters listed below are referenced in this service manual for use in diagnosis. If all values are within the typical range described below, refer to *Symptoms - Hybrid Controls on page 9-167* for diagnosis.

Automatic Transmission Auxiliary Fluid Pump Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Vehicle ON/Closed Throttle/Park or Neutral/Accessories OFF unless otherwise noted			
Auxiliary Transmission Fluid Pump Command	—	Varies	This indicates the commanded torque value for auxiliary transmission fluid pump.
Auxiliary Transmission Fluid Pump Current	—	Varies	This indicates the DC current consumed by hybrid auxiliary transmission fluid pump.
Auxiliary Transmission Fluid Pump Inverter DC Voltage	—	Varies	This indicates the voltage on the HV DC bus as measured by the auxiliary transmission fluid pump control module.
Auxiliary Transmission Fluid Pump Motor Control Module Output Driver Temperature Sensor 1	—	Varies	This indicates the temperature at the inverter within the auxiliary transmission fluid pump control module.
Auxiliary Transmission Fluid Pump Negative Supply Isolation Voltage	—	Varies	This indicates the high voltage negative to chassis voltage as measured by the auxiliary transmission fluid pump control module.
Auxiliary Transmission Fluid Pump Phase U Current	—	Varies	This indicates the current flow to phase U of auxiliary transmission fluid pump motor.
Auxiliary Transmission Fluid Pump Phase V Current	—	Varies	This indicates the current flow to phase V of auxiliary transmission fluid pump.
Auxiliary Transmission Fluid Pump Phase W Current	—	Varies	This indicates the current flow to phase W of auxiliary transmission fluid pump motor.
Auxiliary Transmission Fluid Pump Positive Supply Isolation Voltage	—	Varies	This indicates the high voltage positive to chassis voltage as measured by the auxiliary transmission fluid pump control module.

Automatic Transmission Auxiliary Fluid Pump Control Module Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Description
Auxiliary Transmission Fluid Pump	—	Varies	This indicates the actual torque value of hybrid auxiliary transmission fluid pump.
Auxiliary Transmission Fluid Pump	—	Varies	This indicates the speed, in revolutions per minute, of hybrid auxiliary transmission fluid pump.
Auxiliary Transmission Fluid Pump Motor Torque	—	Varies	This indicates the actual torque value for auxiliary transmission fluid pump.
Ignition 1 Signal	—	Varies	This parameter displays the voltage of the ignition feed circuit of the hybrid powertrain control module.
Hybrid Powertrain Control Module High Voltage Circuit	—	Varies	This displays the high voltage circuit voltage as monitored by the hybrid powertrain control module which detects voltage in a range from 0–655.35 V.

Automatic Transmission Auxiliary Fluid Pump Control Module Scan Tool Output Controls

Output Control	Description
Aux. Trans. Pump Speed	• The hybrid powertrain control module commands the auxiliary transmission fluid pump control module to turn the auxiliary pump ON and OFF. Additionally, the hybrid powertrain control module commands the auxiliary pump to operate at a certain speed (RPM). • When operating the Auxiliary Transmission Oil Pump Speed control, the electric motor speed must be 0 RPM.

Body Control Module Scan Tool Information

Body Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Definition
Operating Conditions: Ignition ON, Vehicle in Park, All Doors Closed			
5 V Ignition Switch	—	Accessory / Key Out	The scan tool displays Off, Accessory, Run, or Crank. This parameter displays the ignition switch mode.
Accent Lighting 1 Command	—	Varies	This parameter displays the interior lighting ambient 1 command as a percentage.
Accent Lighting 2 Command	—	Varies	This parameter displays the interior lighting ambient 2 command as a percentage.
Accessory	—	Active	The scan tool displays Active or Inactive.
Accessory Power Mode Indicator Command	—	Varies	This parameter displays ignition switch accessory LED PWM command as a percentage.
Accessory Relay Command	—	Active	The scan tool displays Active or Inactive.
Accessory/Retained Accessory Power Relay Command	—	Active	The scan tool displays Active or Inactive. This parameter displays the retained accessory power relay status.
All Doors Lock Command	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the door lock status.
Ambient Light Sensor	—	Varies	The scan tool displays volts. This parameter displays the ambient light sensor signal voltage.
Ambient Light Status	—	Night	The scan tool displays Unknown, Night, or Day. This parameter displays the ambient light level status.
Automatic Headlamps Disable Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the headlamp disable switch status.
Automatic Transmission Manual Shift Switch	—	Off	The scan tool displays Off or On. This parameter displays the transmission tap up tap down switch status.

Body Control Module Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Definition
Backup Lamps Relay Command	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the backup lamps relay status.
Battery Current Sensor	—	Varies	The scan tool displays the battery current in amperes.
Battery Low at Start	—	Inactive	The scan tool displays Active or Inactive. This parameter displays Active when the battery level is low when the vehicle starts.
Battery Reconnect Detected	—	No	The scan tool displays No or Yes when a battery disconnect/reconnect event has been detected.
Battery Voltage	—	Varies	The scan tool displays the current battery voltage.
BCM-Controlled Charging Voltage	—	Active	The scan tool displays Active or Inactive.
BCM-Requested Charging Voltage Reduction	—	Inactive	The scan tool displays Active or Inactive. This parameter displays Active when the BCM has detected a low battery voltage condition.
Boot Software Part Number	—	Varies	The scan tool displays the boot software part number.
Brake Lamp Command	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the brake lamp command status.
Brake Pedal Applied	—	Inactive	The scan tool displays Active or Inactive.
Brake Pedal Initial Travel Position Achieved	—	No	The scan tool displays No or Yes.
Brake Pedal Position Sensor	—	Varies	This displays Counts. This numeric value is the current brake pedal position.
Brake Pedal Position Sensor High Voltage During Learn	—	No	The scan tool displays No or Yes.
Brake Pedal Position Sensor Learn	—	No	The scan tool displays No or Yes. This parameter displays Yes when the brake pedal position sensor has learned.
Brake Pedal Position Sensor Learned Home Position	—	Yes	The scan tool displays No or Yes. This parameter displays Yes when the brake pedal position sensor has learned the home position.
Brake Pedal Position Sensor Learned Released Position	—	Yes	The scan tool displays No or Yes. This parameter displays Yes when the brake pedal position sensor has learned the released position.
Brake Pedal Position Sensor Learned Released Position	—	Varies	The scan tool displays volts.
Brake Pedal Position Sensor Learned Released Position	—	Varies	The scan tool displays percentage.
Brake Pedal Position Sensor Low Voltage During Learn	—	No	The scan tool displays No or Yes.
Brake Pedal Position Sensor Move During Learn	—	No	The scan tool displays No or Yes. This parameter displays the brake pedal sensor learn status.
Brake Pedal Position Sensor Pulled Up from Home Position	—	No	The scan tool displays No or Yes.
Brake Pedal Position Sensor Reference	—	Varies	The scan tool displays the brake pedal position as voltage value. This parameter displays the current brake pedal position sensor reference.
Brake Pedal Pulled Up from Home Position	—	No	The scan tool displays No or Yes.
Brake Pedal Pulled Up from Released Position	—	No	The scan tool displays No or Yes.
Brake Transmission Shift Interlock Solenoid Actuator	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the remote start diagnostic status history.
Brake Transmission Shift Interlock Solenoid Actuator Command	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the last remote start diagnostic status history.

Body Control Module Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Definition
Calculated Brake Pedal Position	—	Varies	The scan tool displays volts.
Calculated Brake Pedal Position	—	Varies	The scan tool displays percentage.
Calibration Part Number 1-20	—	Varies	The scan tool displays the software module calibration part number.
Center Brake Lamp Command	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the center brake lamp status.
Center Stop Lamp Command	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the center stop lamp status.
Central Door Lock Switch on Center Console/Passenger Door Lock Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver door lock switch status.
Child Security Lock Indicator Command	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the child security lock indicator command status.
Child Security Lock Motors Command	—	Inactive	The scan tool displays Active or Inactive.
Child Security Lock/Window Lockout Switch	—	Inactive	The scan tool displays Active or Inactive.
Child Security Lock/Window Lockout Switch Indicator Command	—	Inactive	The scan tool displays Active or Inactive.
Content Theft Deterrent Alarm Status	—	Disarmed	The scan tool displays Off, Armed, or Disarmed. This parameter displays the content theft alarm status.
Content Theft Deterrent Disarmed Until Vehicle Closed	—	No	The scan tool displays No or Yes. This parameter displays the content theft deterrent system status.
Content Theft Deterrent Mode	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Content Theft Deterrent Trigger History 1-3	—	None	The scan tool displays None, Driver door, Passenger door, Left rear door, Right rear door, Rear closure, Midgate, Tonneau Cover, Hood, Ignition Voltage, Intrusion, Inclination, Telematics enhanced service alarm, Battery reconnect detected, Unauthorized PWM change, Security Indicates Tamper, or Glass Breakage. This parameter displays the content theft deterrent trigger history status.
Courtesy Lamps Duty Cycle Command	—	Varies	This parameter displays the interior lights dimming command as a percentage.
Crank Abort	—	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Cruise Charging Set Level	—	Varies	This parameter displays cruise charging set level.
Cruise Control Switch Status	—	OFF	The scan tool displays CANCEL, OFF, ON, RESUME, SET or ERROR. This parameter displays the cruise control switch status.
Current Content Theft Deterrent Trigger	—	None	The scan tool displays None, Driver door, Passenger door, Left rear door, Right rear door, Rear closure, Midgate, Tonneau Cover, Hood, Ignition Voltage, Intrusion, Inclination, Telematics enhanced service alarm, Battery reconnect detected, Unauthorized PWM change, Security Indicates Tamper, Glass Breakage. This parameter displays the content theft deterrent current alarm trigger.
Current Driver	—	1-8	This parameter displays the current driver in vehicle.
Disable Battery Saver Relay Command	—	Inactive	The scan tool displays Active or Inactive.

Body Control Module Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Definition
Dome Lamp Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the dome lamp switch status.
Door Lock Switch	—	Inactive	The scan tool displays Active or Inactive.
Driver Door Ajar Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver door Ajar switch status.
Driver Door Key Unlock Switch	—	Inactive	The scan tool displays Active or Inactive.
Driver Door Lock Switch	—	Inactive	The scan tool displays Active or Inactive.
Driver Door Unlatch Command	—	Inactive	The scan tool displays Active or Inactive.
Driver Door Unlock Command	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver door unlock command status.
Driver Seat Heating Switch	—	Inactive	The scan tool displays Active or Inactive.
Driver Seat Heating/Venting/ Cooling Mode	—	Off	The scan tool displays On or Off.
Driver Seat Ventilation Switch	—	Inactive	The scan tool displays Active or Inactive.
Driver Window Learned	—	Yes	The scan tool displays No or Yes.
Driver Window Main Control Down Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver window main control down switch input status.
Driver Window Main Control Express Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver window switch express input status.
Driver Window Main Control Up Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver window switch UP input status.
Driver Window Motor Mode	—	Local Switch Overridden	The scan tool displays Down, Express Down, Express, Up, Error, Inhibit, or Local Switch Overridden. This parameter displays the driver window motor mode status.
Driver Window Motor Reversing Status	—	No	The scan tool displays No or Yes.
Driver Window Motor Sensing System Fault Status	—	No	The scan tool displays No or Yes.
Driver Window Motor Undervoltage Status	—	No	The scan tool displays No or Yes.
Enable Battery Saver Relay Command	—	Inactive	The scan tool displays Active or Inactive.
End Model Part Number	—	Varies	This parameter displays the end model part number.
Engine Stalled	—	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Environment Identification	—	Unknown	The parameter displays the vehicle environment identification successful status.
Front Fog Lamps Relay Command	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the front fog lamp relay status.
Front Fog Lamps Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the front fog lamp switch status.
Front Passenger Window Main Control Down Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the front passenger window down switch status.
Front Passenger Window Main Control Express Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger window switch express input status.

Body Control Module Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Definition
Front Passenger Window Main Control Up Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger window switch UP input status.
Front Tire Pressure on Placard	—	Varies	The scan tool displays kPa or PSI. This parameter displays the specified tire pressure placard information programmed in the BCM for tire pressure monitoring.
Fuel Economy Mode Inhibited - Low Charging Voltage	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the fuel economy mode status.
Generator Regulator Setpoint	—	Varies	The scan tool displays percentage.
Glove Box Unlatch Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the instrument panel compartment release switch status.
Hazard Lamps Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the hazard lamps switch status.
Hazard Lamps Switch Backlight Command	—	Varies	The scan tool displays percentage. This parameter displays hazard switch backlight level PWM command status.
Headlamps On Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the headlamp on switch status.
Headlamps Flash Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the headlamps flash to pass switch status.
Headlamp Washer Relay Command	—	Inactive	The scan tool displays Active or Inactive.
High Beam Select Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the high beam switch status.
High Beam Command	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the high beam command status.
Hood Ajar Switch	—	Inactive	This parameter display the remote start diagnostic status history or the last remote start diagnostic status history.
Hood Ajar Switch Signal 1	—	Inactive	This parameter display the remote start diagnostic status history or the last remote start diagnostic status history.
Hood Position	—	CLOSED	The scan tool displays CLOSED, AJAR, or OPENED. This parameter displays the hood position.
Horn Relay Command	—	Inactive	The scan tool displays Active or Inactive.
Horn Switch	—	Inactive	The scan tool displays Active or Inactive.
Idle Boost Level 2-3 Counter	—	Varies	This parameter displays the state of the idle boost level as counts.
Idle Charging Set Level	—	Varies	This parameter displays idle charging set level.
Ignition Mode Switch Dimming Command	—	Varies	The scan tool displays percentage.
Ignition Switch Reference	—	Varies	This parameter displays the ignition switch voltage reference.
Ignition Switch Signal Voltage	—	Varies	This parameter displays the ignition switch signal voltage.
Ignition Switch Status	—	Inactive	This parameter displays the ignition switch status.
Immobilizer Allows Engine To Start	—	Unknown	The scan tool displays Unknown, Incorrect, Not Allowed, or Valid. This parameter displays the immobilizer status.
Immobilizer Automatic Learn Timer	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the automatic learn timer status.

Body Control Module Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Definition
Immobilizer Environment Device 1-4	—	Unknown	The scan tool displays Incorrect, Correct, Not Received, Not Programmed or Unknown. This parameter displays the immobilizer source status.
Immobilizer Password Learn	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the password learn status.
Immobilizer Password Learn Scan Tool Delay	—	Varies	This parameter displays the auto learn timer status.
Immobilizer Security Code Accepted	—	No	The scan tool displays No or Yes.
Immobilizer Security Code Lockout	—	No	The scan tool displays No or Yes.
Immobilizer Security Code Programmed	—	Yes	The scan tool displays No or Yes.
In Park Switch Status	—	On	The scan tool displays On or Off. This parameter displays the park switch status.
Inadvertent Load Command	—	Active	The scan tool displays Active or Inactive.
Indicator Dimming Duty Cycle Command	—	Varies	The scan tool displays percentage. This parameter displays indicator lighting PWM command status.
Interior/Courtesy Lighting Master Switch	—	Door	The scan tool displays Door or other lighting switch status.
Interior Trunk Lid/Liftgate Window Unlatch Switch	—	Inactive	The scan tool displays Active or Inactive.
Key Capture Solenoid Actuator	—	Active	The scan tool display Active or Inactive. This parameter displays column lock input status.
Key Fob 1-4 Battery Status	—	OK	The scan tool displays OK or other key fob battery status. This parameter displays the key fob battery status.
Key Fob 1-4 Function	—	Undefined	The scan tool displays Inactive, Lock, Unlock Driver Door, All Door Unlock, Release Rear Closure, Actuate Left Sliding Door, Actuate Right Sliding door, Panic Alarm, Release Fuel door, Actuate Power Windows, Actuate Folding Top, Start Engine, Stop Engine, Programmed, Locator Alarm, Close Liftgate, Open Liftgate, Stop Liftgate While Closing, Stop Liftgate While opening, Deadlock All Doors, Stop Liftgate Motion, Start Liftgate Motion, Stop Left Sliding Door Motion, Stop Right Sliding Door Motion, Comfort open, or Comfort close. This parameter displays the key fob function status.
Key Fob in Vehicle	—	Inactive	This parameter displays the current key fob in the vehicle.
Key In Cylinder Switch	—	Active	The scan tool displays Active or Inactive.
Key In Cylinder Switch/Key Fob in Vehicle	—	Yes	The scan tool displays No or Yes.
Key in Ignition Status	—	Inactive	The scan tool displays Key Out or Key In. This parameter displays the key in ignition status.
Key Part Number	—	Varies	This parameter displays the key part number.
Key Type	—	Master Key	The scan tool displays Unknown, Master Key, Valet Key, Fleet Key, or Unconfigured. This parameter displays the key type.
Last Door Lock Function	—	All Doors Lock	The scan tool displays NO Action, PC UNDB Lock, PC Unlock, Unlock, Unlock Driver, Unlock Passenger, Unlock Left Rear, Unlock Right Rear, Unlock Cargo Liftgate, Unlock Driver Side, Unlock Passenger Side, Unlock Non Driver, Unlock All, Lock All, DBL Lock, or UNDBL Lock.
LED Backlight Dimming Command	—	Varies	The scan tool displays as a percentage. This parameter displays LED backlight dimming PWM command status.

Body Control Module Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Definition
Left Brake Lamp Command	—	Varies	The scan tool displays percentage. This parameter displays left brake lamp command status.
Left Dedicated Daytime Running Lamp Command	—	Varies	The scan tool displays percentage. This parameter displays left dedicated daytime running lamp command status.
Left Front Tire Pressure	—	Varies	This parameter displays left front tire pressure in PSI.
Left Front Tire Pressure Sensor Identification	—	Varies	This parameter displays left front tire pressure sensor ID.
Left Front Tire Pressure Sensor Location Learned	—	Yes	The scan tool displays No or Yes. This parameter display tire pressure monitor system learned status.
Left Front Tire Pressure Sensor Mode	—	Learn Mode — Pressure Triggered	The scan tool parameter displays Learn Mode, Undefined, Remeasure Data Mode, Rolling Mode, Enter Off Mode, Exit Off Mode, or Learn Mode Pressure Triggered.
Left Front Tire Pressure Status	—	Normal	The scan tool displays Unknown, Normal, Very Low Pressure, Low, Weak Signal, or High.
Left Front Turn Signal Bulb Out Feedback	—	Inactive	The scan tool displays Active or Inactive.
Left Front Turn Signal/ Hazard Lamp Command	—	Inactive	The scan tool displays Active or Inactive.
Left Low Beam/Daytime Running Lamp Command	—	Varies	The scan tool displays percentage. This parameter displays left low beam/daytime running lamp status.
Left Park Lamps Command	—	Varies	The scan tool displays percentage. This parameter displays rear exterior lighting status.
Left Rear Child Security Lock Switch	—	Inactive	This parameter displays Active or Inactive.
Left Rear Door Ajar Switch	—	Inactive	This parameter displays Active or Inactive. This parameter displays the left rear door ajar switch status.
Left Rear Tire Pressure	—	Varies	This parameter displays left rear tire pressure in PSI.
Left Rear Tire Pressure Sensor Identification	—	Varies	This parameter displays left rear tire pressure sensor ID.
Left Rear Tire Pressure Sensor Location Learned	—	Yes	The scan tool displays No or Yes. This parameter displays tire pressure monitor system learned status.
Left Rear Tire Pressure Sensor Mode	—	Stationary	The scan tool displays Learn Mode, Undefined, Remeasure Data Mode, Rolling Mode, Enter Off Mode, Exit Off Mode, or Learn Mode Pressure Triggered.
Left Rear Tire Pressure Status	—	Normal	The scan tool displays Unknown, Normal, Very Low Pressure, Low, Weak Signal, or High.
Left Rear Turn Signal Bulb Out Feedback	—	Inactive	The scan tool displays Active or Inactive. The parameter displays turn lamp outage status.
Left Rear Turn Signal/Hazard Lamp Command	—	Inactive	The scan tool displays Active or Inactive.
Left Rear Window Learned	—	Yes	The scan tool displays No or Yes.
Left Rear Window Main Control Down Switch	—	Inactive	The scan tool display Active or Inactive. This parameter displays driver window switch inputs.
Left Rear Window Main Control Express Switch	—	Inactive	The scan tool display Active or Inactive. This parameter displays driver window switch inputs.
Left Rear Window Main Control Up Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays driver window switch inputs.
Left Rear Window Motor Mode	—	Local Switch Overridden	The scan tool displays Down, Express, Up, Inhibit, or Local Switch Overridden.
Left Rear Window Switch at Door	—	Inactive	The scan tool displays Active or Inactive.
Left Stop Lamp Command	—	Varies	The scan tool display percentage.
Left Turn Signal Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the left turn signal switch status.

Body Control Module Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Definition
License Plate Lamps Command	—	Inactive	The scan tool displays Active or Inactive.
Load Reduction Level 2-3 Counter	—	Varies	The scan tool display as counts.
Low Beam Relay Command	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the headlamp low beam relay status.
Manufacturers Enable Counter	—	Varies	This parameter tool displays various counter values.
Master Keys Learned	—	Varies	This parameter displays the total number of master keys learned.
Module Diagnostic Address	—	Varies	This parameter displays module diagnostic address.
Number of Key Fobs In Vehicle	—	1	This parameter displays the number of fobs located in the vehicle.
Odometer	—	Varies	This parameter displays the vehicle mileage.
Outside Rear View Mirror Courtesy Lamp Command	—	Inactive	The scan tool displays Active or Inactive. This parameter displays front exterior lighting status.
Park Brake Switch	—	Active	The scan tool displays Active or Inactive. This parameter displays front exterior lighting status.
Park Lamps Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays Active when the parklamp switch is activated.
Passenger Door Ajar Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger door ajar switch status.
Passenger Door Lock Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger door lock switch status.
Passenger Door Unlock Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger door unlock switch status.
Passenger Door(s) Unlatch Command	—	Inactive	The scan tool displays Active or Inactive.
Passenger Door(s) Unlock Command	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger door unlock status.
Passenger Seat Heating Switch	—	Inactive	The scan tool displays Active or Inactive.
Passenger Seat Heating/ Venting/Cooling Mode	—	Off	The scan tool displays On or Off.
Passenger Seat Ventilation Switch	—	Inactive	The scan tool displays Active or Inactive.
Passenger Window Learned	—	Yes	The scan tool displays No or Yes. This parameter displays the passenger window learned status.
Passenger Window Motor Mode	—	Local Switch Overridden	The scan tool displays Down, Express, Up, Inhibit, or Local Switch Overridden.
Passenger Window Switch at Door	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger window switch status.
Pickup Bed Cargo Lamp Command	—	Varies	The scan tool displays percentage. This parameter displays pickup bed cargo lamp command status.
Previous Key Type	—	Unknown	This parameter displays previous driver identification device type.
Primary Key Status	—	Yes	The scan tool displays No or Yes.
Push Button Ignition Switch	—	Inactive	The scan tool displays Active or Inactive.
Push Button Ignition Switch Voltage	—	Varies	This parameter displays the push button ignition switch voltage.

Body Control Module Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Definition
Rain Sensor	—	Inactive	The scan tool displays Active or Inactive.
Rear Closure Ajar Switch	—	Active	The scan tool displays Active or Inactive.
Rear Closure Cylinder Lock Switch	—	Inactive	The scan tool displays Active or Inactive.
Rear Closure Cylinder Unlock Switch	—	Inactive	The scan tool displays Active or Inactive.
Rear Tire Pressure on Placard	—	Varies	This parameter displays the rear tire pressure in kPa or PSI. This parameter displays the specified tire pressure placard information programmed in the BCM for tire pressure monitoring.
Regulated Voltage Control Mode	—	Voltage	The scan tool displays voltage.
Remote Vehicle Start Attempts Exhausted	—	Varies	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history or remaining start attempts.
Remote Vehicle Start Crank Time	—	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Remote Vehicle Start Disabled by Driver	—	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Remote Vehicle Start Source	—	Ignition Switch Start	The scan tool displays Ignition Switch Start or Remote Vehicle Start.
Remote Vehicle Starts Exhausted	—	Varies	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history or remaining remote starts.
Right Brake Lamp Command	—	Varies	The scan tool display percentage. This parameter displays right brake lamp PWM command status.
Right Dedicated Daytime Running Lamp Command	—	Varies	The scan tool display percentage. This parameter displays right dedicated DRL PWM command status.
Right Front Tire Pressure	—	Varies	This parameter displays right front tire pressure in PSI.
Right Front Tire Pressure Sensor Identification	—	Varies	This parameter displays right front tire pressure sensor ID.
Right Front Tire Pressure Sensor Location Learned	—	Yes	The scan tool displays No or Yes.
Right Front Tire Pressure Sensor Mode	—	Stationary	The scan tool displays Learn Mode, Undefined, Remeasure Data Mode, Rolling Mode, Enter Off Mode, Exit Off Mode or Learn Mode Pressure Triggered.
Right Front Tire Pressure Status	—	Normal	The scan tool displays Unknown, Normal, Very Low Pressure, Low, Weak Signal, or High.
Right Front Turn Signal Bulb Out Feedback	—	Inactive	The scan tool displays Active or Inactive.
Right Front Turn Signal/ Hazard Lamp Command	—	Inactive	The scan tool displays Active or Inactive.
Right Low Beam/Daytime Running Lamp Command	—	Varies	The scan tool displays percentage. This parameter displays right low beam/daytime running lamp status.
Right Park Lamps Command	—	Varies	The scan tool displays percentage. This parameter displays rear exterior lighting status.
Right Rear Child Security Lock Switch	—	Inactive	The scan tool displays Active or Inactive.
Right Rear Door Ajar Switch	—	Inactive	The scan tool displays Active or Inactive.
Right Rear Tire Pressure	—	Varies	This parameter displays right rear tire pressure in PSI.
Right Rear Tire Pressure Sensor Identification	—	Varies	This parameter displays right rear tire pressure sensor ID.
Right Rear Tire Pressure Sensor Location Learned	—	Yes	The scan tool displays No or Yes.

Body Control Module Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Definition
Right Rear Tire Pressure Sensor Mode	—	Learn Mode — Pressure Triggered	The scan tool displays Learn Mode, Undefined, Remeasure Data Mode, Rolling Mode, Enter Off Mode, Exit Off Mode, or Learn Mode Pressure Triggered. This parameter displays the pressure sensor mode status.
Right Rear Tire Pressure Status	—	Normal	The scan tool displays Unknown, Normal, Very Low Pressure, Low, Weak Signal or High. This parameter displays the right rear tire pressure status.
Right Rear Turn Signal Bulb Out Feedback	—	Inactive	The scan tool displays Active or Inactive.
Right Rear Turn Signal/ Hazard Lamp Command	—	Inactive	The scan tool displays Active or Inactive.
Right Rear Window Main Control Down Switch	—	Inactive	The scan tool displays Active or Inactive.
Right Rear Window Main Control Express Switch	—	Inactive	The scan tool displays Active or Inactive.
Right Rear Window Main Control Up Switch	—	Inactive	The scan tool displays Active or Inactive.
Right Rear Window Motor Mode	—	Local Switch Overridden	The scan tool displays Down, Express, Up, Inhibit, or Local Switch Overridden.
Right Rear Window Switch at Door	—	Inactive	The scan tool displays Active or Inactive.
Right Stop Lamp Command	—	Varies	The scan tool displays percentage.
Right Turn Signal Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the right turn signal switch status.
Run Abort	—	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Run Relay Command	—	Active	The scan tool displays Active or Inactive.
Run/Crank	—	Inactive	The scan tool displays Active or Inactive.
Run/Crank Relay Command	—	Active	The scan tool displays Active or Inactive.
Run/Crank Power Mode Indicator Command	—	Varies	The scan tool displays percentage. This parameter displays ignition switch run LED PWM command status.
Secondary Key Status	—	No	The scan tool displays No or Yes.
Security Indicator Command	—	Varies	The scan tool displays percentage. This parameter displays security LED PWM command status.
Selected Front Tire Type	—	Standard Load	The scan tool displays No Tire Type, Metric Standard Load, Metric Extra Load, Load Range C, Load Range D, or Load Range E. This parameter displays the front tire type.
Selected Rear Tire Type	—	Standard Load	The scan tool displays No Tire Type, Metric Standard Load, Metric Extra Load, Load Range C, Load Range D, or Load Range E. This parameter displays the rear tire type.
Start-Up State of Charge	—	Varies	The scan tool displays percentage. This parameter displays startup state of charge status.
State of Charge	—	Varies	The scan tool displays percentage. This parameter displays state of charge status.
Sunroof Enabled	—	Active	The scan tool displays Active or Inactive.
Sunroof Motor Overtemperature	—	Inactive	The scan tool displays Active or Inactive.
Sunroof Not Learned	—	Inactive	The scan tool displays Active or Inactive.
Sunroof Position	—	Closed	The scan tool displays Closed, Open, Venting, Comfort Open, Closing, Opening. This parameter displays the current sunroof position.

Body Control Module Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Definition
Sunroof Remote Command	—	Inactive	The scan tool displays Sunroof Secure Close, Venting, Close, or Open. This parameter displays the last sunroof remote command.
Sunroof Slide Switch	—	Inactive	The scan tool displays Inactive, Express Open, Open, Express Close, Close, Short to Ground, Short to Battery, or Stuck. This parameter displays the sunroof slide switch status.
Sunroof Tilt Switch	—	Inactive	The scan tool displays Inactive, Open, Close, Short to Ground, Short to Battery or Stuck. This parameter displays the sunroof tilt switch status. When the switch experiences a malfunction Short to Ground, Short to Battery or Stuck will be displayed.
Sunroof/Sunshade Motor Overtemperature	—	Inactive	The scan tool displays Active or Inactive.
Sunroof/Sunshade Switch	—	Inactive	The scan tool displays Inactive, Express Open, Open, Express Close, Close, Short to Ground, Short to Battery, or Stuck. This parameter displays the sunroof or sunshade switch status.
Sunshade Enabled	—	Active	The scan tool displays Active or Inactive.
Sunshade Not Learned	—	Inactive	The scan tool displays Active or Inactive.
Sunshade Position	—	Closed	The scan tool displays Ajar, Closed, Opened, Closing, or Opening. This parameter displays the sunshade position status.
Sunshade Remote Command	—	Inactive	The scan tool displays Close or Open. This parameter displays the last sunshade remote command.
Tamper Status	—	No	The scan tool displays No or Yes.
Telematics Enhanced Service Override Active	—	No	The scan tool displays No or Yes. This parameter displays vehicle theft deterrent system status.
Total Keys Learned	—	Varies	This parameter displays the number of keys learned.
Traction Control Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays Active when the traction control switch is active.
Transponder Authentication	—	Initializing	The scan tool displays Inactive, Initializing, ID Received, Password Received, Data Reception Complete, or Data Transmission Complete. This parameter displays the transponder key communication status.
Transponder Key Status	—	OK	The scan tool displays OK, LIN Bus Initialization Malfunction, Antenna Initialization Malfunction, Password Error, No Valid Key Detected, LIN Bus Communication Malfunction, or Antenna Malfunction. This parameter displays the transponder key communication error status.
Trunk Lamp Command	—	Varies	The scan tool displays as percentage.
Trunk Lid/Liftgate Window Exterior Unlatch Switch	—	Inactive	The scan tool displays Active or Inactive.
Trunk Lid/Liftgate Window Unlatch Command	—	Inactive	The scan tool displays Active or Inactive.
Valet Keys Learned	—	Varies	This parameter displays the number of valet keys learned.
Valet Mode Status	—	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Valet switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays Active when the valet switch is on.
Vehicle Identification Number (VIN)	—	Varies	This parameter displays the vehicle identification number.
Window Lockout Switch	—	Inactive	The scan tool displays Active or Inactive.

Body Control Module Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Definition
Window Lockout Switch Indicator Command	—	Inactive	The scan tool displays Active or Inactive.
Windshield Washer Relay Command	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the windshield washer relay status.
Windshield Washer Switch	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the windshield washer switch status.
Windshield Wiper Park Switch	—	Active	The scan tool displays Active or Inactive.
Windshield Wiper High Speed Relay Command	—	Inactive	The scan tool displays Active or Inactive.
Windshield Wiper High Speed Switch	—	Inactive	The scan tool displays Active or Inactive.
Windshield Wiper Motor Relay Command	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the windshield wiper relay status.
Windshield Wiper Stalled During Sweep	—	Inactive	The scan tool displays Active or Inactive.
Windshield Wiper Stalled in Park Position	—	Inactive	The scan tool displays Active or Inactive. This parameter displays the windshield wiper stalled status.
Windshield Wiper Switch	—	Off	The scan tool displays Off, Delay 1, Delay 2, Delay 3, Delay 4, Delay 5, or Low. This parameter displays the windshield wiper switch status.

Body Control Module Scan Tool Output Controls

Scan Tool Output Control	Description
Accent Lighting 1	The BCM activates the accent lighting when you select On. The value should be 100%. All accent lighting should illuminate until commanded Off.
Accent Lighting 2	The BCM activates the accent lighting when you select On. The value should be 100%. All accent lighting should illuminate until commanded Off.
Accessory Power Mode Indicator	The BCM activates the accessory indicator when you select On. The value should be 100%. The yellow LED accessory indicator on start button should illuminate until commanded Off.
Accessory Power Relay	The BCM actuates the accessory power relay when you select On. The accessory power relay should turn on allowing specific vehicle functions to operate.
Accessory/Retained Accessory Power Relay	The BCM actuates the retained accessory power relay when you select On. The retained accessory power relay should turn on allowing specific vehicle functions to operate.
All Doors Lock	The BCM activates all doors lock when you select Lock. All doors should lock.
All Doors Lock/Unlock	The BCM activates all doors lock/unlock when you select Lock/Unlock.
Auxiliary Ignition Run Relay	The BCM controls the Ignition Run Coil Control circuit to turn it On and Off.
Backup Lamps	The BCM actuates the backup lamps relay when you select On. The backup lamps should illuminate until commanded Off. Engine must be running.
Battery Saver Relay	The BCM activates the battery saver relay when you select Enable. This command sets the low power mode relay in the state in which it does not supply power to the non-essential parts of the vehicle. This is used to prevent the battery from being depleted when the vehicle is not used for a long period of time.
Brake Pedal Position Sensor Learn	The BCM activates the brake pedal position sensor learn when you select Learn. The brake pedal position sensor learn procedure should start.
Brake Transmission Shift Interlock Solenoid Actuator	The BCM activates the transmission shift interlock solenoid actuator when you select On.
Brake Transmission Shift Interlock Indicator	The BCM activates the transmission range indicator when you select On. The transmission range indicator at the shifter should illuminate until commanded Off.
Center Brake Lamp	The BCM activates the center brake lamp when you select On. The center brake lamp should illuminate until commanded Off.

Body Control Module Scan Tool Output Controls (cont'd)

Scan Tool Output Control	Description
Center Stop Lamp	The BCM activates the center stop lamp when you select On. The center stop lamp should illuminate until commanded Off.
Child Security Lock Indicator	The BCM activates the child security lock indicator when you select On. The child security lock indicator should illuminate until commanded Off.
Child Security Lock Motors	The BCM actuates the child security door motor when you select Lock. The child security doors should lock.
Child Security Lock/ Window Lockout Switch Indicator	The BCM activates the child security lock/window lockout switch indicator when you select On. The child security lock/window lockout switch indicator should illuminate until commanded Off.
Clear Driver Window Learned Values	When you select Clear the clear driver window learn procedure should start.
Clear Passenger Window Learned Values	When you select Clear the clear left rear window learn procedure should start.
Courtesy Lamps	The BCM activates the courtesy lamps when you select On. The value should be 100%. The courtesy lamps should illuminate until commanded Off.
Driver Door Unlatch	The BCM activates the output circuit to unlatch the driver door with a passive entry passive start when you select Unlatch. There is NO door handle on this type of vehicle to open the door. Instead, there is a pad that you press to unlatch the door.
Driver Door Unlock	The BCM pulses the driver door unlock motor when you select Unlock. The driver door should unlock.
Driver Window Motor	The BCM activates the driver window motor when you select Up/Down/Stop/Express Up/Express Down. The driver window should follow the appropriate command.
Driver Window Motor Mode	The BCM activates the driver window motor when you select Up/Down/Stop/Express Up/Express Down. The driver window should follow the appropriate command.
Front Fog Lamps	The BCM actuates the front fog lamps relay when you select On. The front fog lamps relay should turn on.
Generator Regulator Setpoint	The BCM changes the output of the generator.
Hazard Lamps Switch Backlight	The BCM activates the hazard lamps switch when you select On. The value should be 100%. The hazard lamps switch backlight should illuminate until commanded Off.
High Beams	The BCM activates the high beam command when you select On. The high beam lights should illuminate. The headlamps have to be on.
Horn Relay	The BCM activates the horn when you select On. The horn should sound.
Inadvertent Load	The BCM activates the inadvertent load command when you select On. (It is an electronic request to shut down an electrical or electronic device that is drawing power from the battery at a time when there should be no activity, usually after the key has been removed from the ignition for a period of time.)
Incandescent Dimming	The BCM activates the incandescent light dimming when you select On. The values should be 100%. The incandescent light dimming should illuminate until commanded Off.
Indicator Dimming	The BCM activates the indicator dimming when you select On. The values should be 100%. The indicator should illuminate until commanded Off.
LED Backlight Dimming	The BCM activates the LED backlight dimming when you select On. The values should be 100%. The LED backlight dimming for control switches should illuminate until commanded Off.
Left Brake Lamp	The BCM activates the left brake lamp when you select On. The values should be 100%. The left brake lamp should illuminate until commanded Off.
Left Dedicated Daytime Running Lamp	The BCM activates the left dedicated daytime running lamp when you select ON. The value changes to 100%. The left daytime running lamp should illuminate.
Left Front Park Lamp	The BCM activates the left front park lamp when you select ON with a value of 100%. The left front park lamp should illuminate.
Left Front Park Lamp/ Daytime Running Lamp	The BCM activates the left front park lamp/daytime running lamp when you select ON with a value of 100%. The left front park lamp/daytime running lamp should illuminate.
Left Front Turn Signal Lamp	The BCM activates the left front turn signal lamp when you select On. The left front turn signal lamp should illuminate until commanded Off.
Left Headlamp Lamp Low Beam	The BCM activates the left headlamp low beam when you select On. The values should be 100%. The left headlamp low beam should illuminate until commanded Off.

Body Control Module Scan Tool Output Controls (cont'd)

Scan Tool Output Control	Description
Left Park Lamps	The BCM activates the left park lamps when you select ON with a value of 100%. The left park lamps should illuminate.
Left Rear Park Lamp	The BCM activates the left rear park lamp when you select ON with a value of 100%. The left rear park lamp should illuminate.
Left Rear Stop/ Park Lamp	The BCM activates the left rear stop/park lamp when you select ON with a value of 100%. The left rear stop/park lamp should illuminate.
Left Rear Turn Signal Lamp	The BCM activates the left rear turn signal lamp when you select On. The left rear turn signal lamp should illuminate until commanded Off.
Left Rear Turn Signal/ Stop Lamp	The BCM activates the left rear turn signal/stop lamp when you select On. The left rear turn signal/ stop lamp should illuminate until commanded Off.
Left Rear Window Motor	The BCM activates the left rear window motor when you select Up/Down/Stop/Express Down. The left rear window should follow the appropriate command.
Left Stop Lamp	The BCM activates the left stop lamp when you select ON with a value of 100%. The left stop lamp should illuminate.
Left Trailer Turn Signal Lamp	The BCM activates the left trailer turn signal lamp when you select ON with a value of 100%. The left trailer turn signal lamp should illuminate.
License Plate Lamps	The BCM activates the license plate lamps when you select On. The license plate lights should turn on until commanded Off.
Liftgate Unlatch	The BCM actuates the rear compartment lid release actuator when you select Unlatch. The trunk or liftgate should open.
LIN Bus Device Identification Data	When you select Update the LIN Bus Device part number and calibration part number should be updated.
Low Beam Lamps	The BCM activates the low beam lamps when you select On. The low beam lamps should turn on.
Low Beam Relay	The BCM activates the low beams when you select On. The low beam lights should turn on.
Outside Rear View Mirror Courtesy Lamp	The BCM activates the outside rear view mirror courtesy lamp when you select On. The outside rear view mirror courtesy lamp (at the bottom) should illuminate.
Passenger Door(s) Unlatch	The BCM activates the output circuit to unlatch the passenger door with a passive entry passive start when you select Unlatch. There is NO door handle on this type of vehicle to open the door. Instead, there is a pad that you press to unlatch the door.
Passenger Door(s) Unlock	The BCM pulses the passenger door unlock motor when you select Unlock. The passenger door should unlock.
Passenger Window Motor	The BCM activates the passenger window motor when you select Up/Down/Stop/Express Up/ Express Down. The passenger window should follow the appropriate command.
Pickup Bed Cargo Lamp	The BCM activates the pickup bed cargo lamp when you select On. The values should be 100%. The pickup bed cargo lamp should illuminate until commanded Off.
Rear Fog Lamp(s) Relay	The BCM activates the rear fog lamps when you select On. The rear fog lamps should turn on.
Right Brake Lamp	The BCM activates the right brake lamp when you select On. The value should be 100%. The right brake lamp should illuminate until commanded Off.
Right Dedicated Daytime Running Lamp	The BCM activates the right dedicated daytime running lamp when you select On. The value should be 100%. The right daytime running lamp should illuminate.
Right Front Park Lamp	The BCM activates the right front park lamp when you select ON with a value of 100%. The right front park lamp should illuminate.
Right Front Park Lamp/ Daytime Running Lamp	The BCM activates the right front park lamp/daytime running lamp when you select ON with a value of 100%. The right front park lamp/daytime running lamp should illuminate.
Right Front Turn Signal Lamp	The BCM activates the right front turn signal lamp when you select On. The right front turn signal/ hazard lamp should illuminate.
Right Headlamp Low Beam	The BCM activates the right headlamp low beam when you select On. The right headlamp low beam should illuminate.
Right Park Lamps	The BCM activates the right park lamps when you select ON with a value of 100%. The right park lamps should illuminate.
Right Rear Park Lamp	The BCM activates the right rear park lamp when you select ON with a value of 100%. The right rear park lamp should illuminate.
Right Rear Stop/ Park Lamp	The BCM activates the right rear stop/park lamp when you select ON with a value of 100%. The right rear stop/park lamp should illuminate.

Body Control Module Scan Tool Output Controls (cont'd)

Scan Tool Output Control	Description
Right Rear Turn Signal Lamp	The BCM activates the right rear turn signal/hazard lamp when you select On. The right rear turn signal lamp should illuminate until commanded Off.
Right Rear Turn Signal/ Stop Lamp	The BCM activates the right rear turn signal/stop lamp when you select On. The right rear turn signal/ stop lamp should illuminate until commanded Off.
Right Rear Window Motor	The BCM activates the right rear window motor when you select Up/Down/Stop/Express Down. The right rear window should follow the appropriate command.
Right Stop Lamp	The BCM activates the right stop lamp when you select ON with a value of 100%. The right stop lamp should illuminate.
Right Trailer Turn Signal Lamp	The BCM activates the right trailer turn signal lamp when you select ON with a value of 100%. The right trailer turn signal lamp should illuminate.
Run Relay	The BCM actuates the run relay when you select On. The run relay should turn on.
Run/Crank Relay	The BCM actuates the run/crank relay when you select On. The run/crank relay should turn on.
Run/Start Power Mode Indicator	The BCM activates the run/start lamp when you select On. The value should be 100%. The green LED on engine start/stop button should illuminate until commanded Off.
Security Indicator	The BCM activates the security indicator command when you select On. The security indicator at center of dash (or at DRL sensor) should illuminate until commanded Off.
Stop Lamps	The BCM activates the stop lamps when you select ON with a value of 100%. The stop lamps should illuminate.
Tire Pressure Sensors Learn	The BCM activates the tire pressure sensor learn procedure when you select Learn.
Tire Type/Pressure Selection	When you select OK, you can change tire type and load range.
Trailer Backup Lamps	The BCM activates the trailer backup lamps when you select ON with a value of 100%. The trailer backup lamps should illuminate.
Trailer Park Lamps	The BCM activates the trailer park lamps when you select ON with a value of 100%. The trailer park lamps should illuminate.
Transmission Range Indicator	The BCM activates the transmission range indicator when you select On. The transmission range indicator at the shifter should illuminate until commanded Off.
Trunk Lamp	The BCM activates the trunk lamp when you select On. The value should be 100%. The trunk lamp should illuminate until commanded Off.
Trunk Lid Unlatch	The BCM activates the trunk lid unlatch when you select On. The trunk lid should unlatch.
Window Lockout Switch Indicator	The BCM activates the window lockout switch indicator when you select On. The window lockout switch indicator should illuminate until commanded Off.
Windshield Washer Relay	The BCM actuates the windshield washer relay when you select On. The windshield washer relay should turn on.
Windshield Wiper High Speed Relay	The BCM actuates the windshield wiper high speed relay when you select On. The windshield wiper high speed relay should turn on.
Windshield Wiper Motor Relay	The BCM actuates the windshield wiper motor relay when you select On. The windshield wiper motor relay should turn on.

Electronic Brake Control Module Scan Tool Information

The Electronic Brake Control Module scan tool data parameters list contains all ABS related parameters that are available on the scan tool. The list is arranged in alphabetical order. A given parameter may appear in any one of the data lists.

Electronic Brake Control Module Scan Tool Data Parameter

Parameter	System State	Expected Value	Description
Operating Conditions: Vehicle ON			
Acceleration Pedal Position Signal Received from ECM	—	Invalid	The scan tool displays Invalid or Valid depending on the accelerator pedal signal received from the ECM.

Electronic Brake Control Module Scan Tool Data Parameter (cont'd)

Parameter	System State	Expected Value	Description
ABS Pump Motor Voltage	—	0 V	The scan tool displays the pump motor voltage.
Antilock Braking System	—	OK	The scan tool displays OK or Malfunction. Malfunction is displayed when the ABS detects a fault.
Brake Fluid Level Sensor	—	OK	The scan tool displays OK when the brake fluid is at correct level and Low when the brake fluid is low.
Brake Controls Brake Pedal Position Sensor Circuit 1	—	Varies	This displays volts. This is the brake controls brake pedal position sensor circuit 1 reference value.
Brake Controls Brake Pedal Position Sensor Circuit 2	—	Varies	This displays percentage. This is the brake controls brake pedal position sensor circuit 2 that calculates the percentage of brake pedal applied or released.
Brake Controls Brake Pedal Position Sen. 5 Volt Supply Voltage	—	Varies	This displays volts. This is the voltage supply to the brake controls brake pedal position sensor.
Brake Controls Brake Pedal Position	—	Varies	The scan tool displays the brake pedal counts. Learned or Not Learned. This is the brake controls brake pedal position sensor zeroed or learned value.
Brake Pedal Position Sensor Signal Received From Body Control Module	Brake pedal released	Inactive	The scan tool displays Inactive or Active depending on the state of the brake pedal.
	Brake pedal applied	Active	
Brake Pressure Sensor	Brake pedal released	0–1 V	The scan tool displays 0–5 V depending on the applied hydraulic brake pressure.
	Brake pedal applied	1–5 V	
Brake Switch, Traction Control Switch Signal Received From Body Control Module	—	Invalid	The scan tool displays Invalid or Valid depending on the signal received from the BCM.
Dynamic Rear Proportioning Status	—	OK	The scan tool displays OK or Malfunction. Malfunction is displayed when the dynamic rear proportioning system is defective.
Lateral Acceleration	—	Varies	The scan tool displays m/s^2. This is the current rate of the vehicle acceleration or deceleration as reported by the lateral accelerometer sensor.
Left Front Inlet Solenoid Valve Feedback	—	Inactive	The scan tool displays Inactive or Active. Active is displayed when the left front inlet solenoid valve is commanded ON.
Left Front Outlet Solenoid Valve Feedback	—	Inactive	The scan tool displays Inactive or Active. Active is displayed when the left front outlet solenoid valve is commanded ON.
Left Front Wheel Speed Sensor	—	0 km/h (MPH)	The scan tool displays km/hr (MPH) depending on the current speed of the left front wheel speed sensor.
Left Rear Inlet Solenoid Valve Feedback	—	Inactive	The scan tool displays Inactive or Active. Active is displayed when the left rear inlet solenoid valve is commanded ON.
Left Rear Outlet Solenoid Valve Feedback	—	Inactive	The scan tool displays Inactive or Active. Active is displayed when the left rear outlet solenoid valve is commanded ON.
Left Rear Wheel Speed Sensor	—	0 km/h (MPH)	The scan tool displays km/h (MPH) depending on the current speed of the left rear wheel speed sensor.
Longitudinal Acceleration	—	Varies	The scan tool displays m/s^2. This is the current rate of the vehicle acceleration or deceleration as reported by the longitudinal accelerometer sensor.
Panic Brake Assist Status	—	OK	The scan tool displays OK or Malfunction. Malfunction is displayed when the panic brake assist system is defective.
Pump Motor Relay Feedback	—	Inactive	The scan tool displays Inactive or Active. Active is displayed when the pump motor is commanded ON.

Electronic Brake Control Module Scan Tool Data Parameter (cont'd)

Parameter	System State	Expected Value	Description
Primary Isolation Solenoid Valve Feedback	—	Inactive	The scan tool displays Inactive or Active. Active is displayed when the isolation solenoid valve is commanded ON.
Primary Prime Solenoid Valve Feedback	—	Inactive	The scan tool displays Inactive or Active. Active is displayed when the prime solenoid valve is commanded ON.
Right Front Inlet Solenoid Valve Feedback	—	Inactive	The scan tool displays Inactive or Active. Active is displayed when the right front inlet solenoid valve is commanded ON.
Right Front Outlet Solenoid Valve Feedback	—	Inactive	The scan tool displays Inactive or Active. Active is displayed when the right front outlet solenoid valve is commanded ON.
Right Front Wheel Speed Sensor	—	0 km/h (MPH)	The scan tool displays km/hr (MPH) depending on the current speed of the right front wheel speed sensor.
Right Rear Inlet Solenoid Valve Feedback	—	Inactive	The scan tool displays Inactive or Active. Active is displayed when the right rear inlet solenoid valve is commanded ON.
Right Rear Outlet Solenoid Valve Feedback	—	Inactive	The scan tool displays Inactive or Active. Active is displayed when the right rear outlet solenoid valve is commanded ON.
Right Rear Wheel Speed Sensor	—	0 km/h (MPH)	The scan tool displays km/h (MPH) depending on the current speed of the right rear wheel speed sensor.
Secondary Isolation Solenoid Valve Feedback	—	Inactive	The scan tool displays Inactive or Active. Active is displayed when the isolation solenoid valve is commanded ON.
Secondary Prime Solenoid Valve Feedback	—	Inactive	The scan tool displays Inactive or Active. Active is displayed when the prime solenoid valve is commanded ON.
Steering Wheel Angle	—	Varies	The scan tool displays °. This is the current position of the steering angle sensor.
Steering Wheel Angle Sensor Centering	—	OK	The scan tool displays OK or Malfunction. Malfunction is displayed when the steering angle sensor center position is not learned.
System Voltage	—	11–14 V	The scan tool displays V. This is the current battery voltage.
Traction Control System	—	OK	The scan tool displays OK or Malfunction. Malfunction is displayed when the traction control system detects a fault.
Traction Control Switch	—	Inactive	The scan tool displays Inactive or Active depending on the state of the traction control switch.
Torque Signal Received From ECM	—	Invalid	The scan tool displays Invalid or Valid depending on the torque signal received from the ECM.
Torque Signal Received From TCM	—	Invalid	The scan tool displays Invalid or Valid depending on the torque signal received from the TCM.
Vehicle Stability Enhancement System Relay Feedback	—	Inactive	The scan tool displays Inactive or Active depending on the state of the stability control.
Vehicle Stability Enhancement System Switch	Traction control switch released	Inactive	The scan tool displays Active or Inactive depending on the status of the vehicle stability control switch.
	Traction control switch pressed and held for five seconds.	Active	
Vehicle Stability System	—	OK	The scan tool displays OK or Malfunction. Malfunction is displayed when the vehicle stability enhancement system is defective.

Electronic Brake Control Module Scan Tool Data Parameter (cont'd)

Parameter	System State	Expected Value	Description
Yaw Rate Signal	—	Varies	This displays °/sec. The scan tool displays the signal received from the yaw rate sensor.

Electronic Brake Control Module Scan Tool Output Controls

Output Control	Description
ABS Pump Motor	Commands the ABS pump motor Increase or Decrease.
Automated Brake Bleed	This is used in order to bleed the ABS hydraulics.
Traction Control Left Front Solenoid Valves	Commands the solenoid valve ON or OFF.
Traction Control Left Rear Solenoid Valves	Commands the solenoid valve ON or OFF.
Traction Control Right Front Solenoid Valves	Commands the solenoid valves ON or OFF.
Traction Control Right Rear Solenoid Valves	Commands the solenoid valves ON or OFF.
ABS Left Front Solenoid Valves	Commands the solenoid valve ON or OFF.
ABS Left Rear Solenoid Valves	Commands the solenoid valve ON or OFF.
ABS Right Front Solenoid Valves	Commands the solenoid valves ON or OFF.
ABS Right Rear Solenoid Valves	Commands the solenoid valves ON or OFF.

Electronic Parking Brake Control Module Scan Tool Information

Parking Brake Control Module Scan Tool Data Parameters

Parameter	Expected Value	Description
Operating Conditions: Ignition ON, Parking Brake Off		
Battery Voltage	Varies	This displays the battery voltage (V).
Calculated System Temperature	Varies	The scan tool displays the parking brake control module temperature in degrees Celsius.
Electric Park Brake Calibration Test Status	Passed	The scan tool displays Passed or Failed. This parameter displays if the park brake calibration is properly programmed into the parking brake control module.
Park Brake Cable Position	Varies	The scan tool displays the current park brake position in counts. When the park brake is fully released the value will be 0 counts which will allow cable disassembly. The park brake cable position counts will display in range of 0-700 counts when released and 701-1300 counts when applied.
Park Brake Motor Command	Off	The scan tool displays On or Off. This parameter displays the status of the park brake motor.
Park Brake Motor Duty Cycle Command	Varies	The scan tool displays the pulse width modulated cycle as a percentage.
Park Brake Release Reason	None	The scan tool displays None, Ign. Cycled, Spd. Threshold, or Brake Applied. This parameter displays the reason the parking brake was released.
Park Brake Status	Released	The scan tool displays Applied, Released, Malfunction or Invalid. This parameter displays the current status of the parking brake.
Park Brake Switch	Inactive	The scan tool displays Applied, Released, Inactive, or Invalid. This parameter displays the current status of the parking brake switch.

Parking Brake Control Module Scan Tool Output Controls

Output Control	Description
Parking Brake Calibration	The electric parking brake module will activate the park brake calibration learn procedure when selected. During the learn procedure the rear brakes will cycle several times.
Parking Brake Cable Service Apply	The electric parking brake module will apply the parking brake cable tension to diagnose a possible EPB switch failure.

Parking Brake Control Module Scan Tool Output Controls (cont'd)

Output Control	Description
Parking Brake Cable Service Release	The electric parking brake module will release the parking brake cable to diagnose a possible EPB switch failure.
Parking Brake Cable Replacement Procedure	The electric parking brake module will unwind the parking brake cable for replacement or service when selected.
Park Brake Reset	The electric parking brake module will reset the park brake actuator when commanded.
Parking Brake Switch Diagnostics	The electric parking brake module will test the parking brake switch signals to verify they are working properly or if there is an open circuit.

K20 Engine Control Module: Scan Tool Information

The ECM scan tool data list contains all ECM related parameters that are available on the scan tool. The list is arranged in alphabetical order. A given parameter may appear in any one of the data lists, and in some cases may appear more than once, or in more than one data list in order to group certain related parameters together.

Use the engine scan tool data list only after the following is determined:

- The *Diagnostic System Check - Vehicle on page 6-91* is completed.
- No diagnostic trouble codes (DTCs)
- On-board diagnostics are functioning properly

The scan tool values from a properly running vehicle may be used for comparison with the vehicle you are diagnosing. The ECM scan tool data list represents values that would be seen on a normally running vehicle.

Note: A scan tool that displays faulty data should not be used. The scan tool concern should be reported to the manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.

Only the parameters listed below are referenced in this service manual for use in diagnosis.

ECM Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Vehicle On/Park or Neutral/Accessories Off/Brake Pedal Released			
14V Power Module Setpoint	Vehicle On	Percent	The target output percentage the 14V Power Module will try to maintain.
14V Power Module Setpoint	Vehicle On	Volts	The target output the 14V Power Module will try to maintain in volts.
5V Reference 1, 2, 3, or 4	Vehicle ON	5V	This parameter displays the voltage sensed on the 5V reference circuits at the control module. The scan tool will display a higher value at higher voltage. The scan tool will display a lower value at lower voltage.
5V Reference 1, 2, 3, or 4 Circuit Status	Vehicle ON	OK	This parameter displays OK if there is no 5V reference circuit condition. If the circuit is shorted to ground or shorted to B+, Malfunction is displayed.
Accelerator Pedal Position	Accelerator pedal not actuated	0%	This parameter displays the angle of the APP as calculated by the control module using the signals from the APP sensors.
	Accelerator pedal fully actuated	100%	
Active Grille Air Shutter Position	%	Varies	The actual PWM duty cycle output to the actuator. Active Grill Air Shutters are flaps controlled by the ECM at the front grille to control the amount of air flow.
Active Grille Air Shutter Position Command	%	Varies	This parameter displays the commanded PWM duty cycle output to the actuator. Active Grill Air Shutters are flaps controlled by the ECM at the front grille to control the amount of air flow.
Ambient Air Temperature	°C (°F)	Varies	This parameter displays the surrounding air temperature, at any given altitude.

ECM Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Description
APP Sensor 1	Accelerator pedal not actuated	0.88–1.08V	This parameter displays the actual voltage on the accelerator pedal position (APP) Sensor 1 signal circuit as measured by the control module.
	Accelerator pedal fully actuated	4.17–4.37V	
APP Sensor 1 Circuit Status	Vehicle ON	OK	This parameter displays the APP Sensor 1 Out of Range indicates that the sensed accelerator pedal position 1 sensor value is currently out of range or that a Malfunction has been detected based upon the sensed accelerator pedal position 1 sensor value being out of range.
APP Sensor 1 Position	Accelerator pedal not actuated	0%	This parameter displays the angle of the APP sensor 1 as calculated by the control module using the signal from the APP sensor 1. APP sensor 1 is a range of values indicating a low percentage when the accelerator pedal is not depressed to a high percentage when the accelerator pedal is fully depressed.
	Accelerator pedal fully actuated	100%	
APP Sensor 2	Accelerator pedal not actuated	0.39–0.59V	This parameter displays the actual voltage on the accelerator pedal position (APP) Sensor 2 signal circuit as measured by the control module.
	Accelerator pedal fully actuated	2.02–2.22V	
APP Sensor 2 Circuit Status	Vehicle ON	OK	This parameter displays the APP Sensor 2 Out of Range indicates that the sensed accelerator pedal position 2 sensor value is currently out of range or that a Malfunction has been detected based upon the sensed accelerator pedal position 1 sensor value being out of range.
APP Sensor 2 Position	Accelerator pedal not actuated	0%	This parameter displays the angle of the APP sensor 2 as calculated by the control module using the signal from the APP sensor 2. APP sensor 2 is a range of values indicating a low percentage when the accelerator pedal is not depressed to a high percentage when the accelerator pedal is fully depressed.
	Accelerator pedal fully actuated	100%	
APP Sensor 2 Learned Applied Position	%	%	This parameter displays the learned maximum (fully applied) position of Accelerator Pedal Position (APP) Sensor 2.
APP Sensor 2 Learned Released Position	—	Volts	This parameter displays the accelerator pedal sensor 2 signal at its minimum learned position (pedal released) as a percentage of its reference voltage. (The minimum learned position is automatically updated) periodically as determined by an algorithm. This is not a static value from a single learn event.)
APP Sensors	—	0%	This parameter displays the average of the APP sensors as calculated by the throttle actuator control (TAC) module. The APP average is a range of values indicating a low percentage when the accelerator pedal is not depressed to a high percentage when the accelerator pedal is fully depressed.
Axle Torque	—	N•m	This parameter displays the torque request for the slow response air path (control of the throttle). Based on current conditions the hybrid controller determines the optimum engine torque, which it sends as a request to the Engine Control Module.

ECM Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Description
Brake Pedal Position Sensor Signal	%	%	This parameter displays the device that measures or monitors the relative position of the brake pedal as it travels from a position where it is fully depressed to a position where the driver's foot is completely off the pedal or vice versa.
Charge Indicator	—	Off	Indicates the status of the charge indicator on the instrument panel cluster.
Cold Temperature Mode	Yes/No	No	The scan tool displays Yes or No. This is the current state of the Cold Temperature Mode.
Cruise Control	Enabled/Disabled	Disabled	This parameter displays the status of the cruise control system as determined by the control module.
Cruise Control Cancel Switch	Cruise Control ON	Active/Inactive/Invalid	This parameter displays the status of the cruise control cancel switch.
Cruise Control Disengage History 1–8	Cruise Control ON	Reason for Cruise Disengagement	The parameter displays the last 8 cruise control disengages in order from 1–8, with 8 being the most recent. There are approximately 40 possible causes for the cruise control to disengage.
Cruise Control Inhibit Reason	Cruise Control ON	Varies	The parameter displays the reason why the cruise control system is inhibited. There are approximately 40 possible causes for the cruise control to be inhibited.
Cruise Control On/Off Switch	Cruise Control ON	ON/OFF	This parameter displays the ECM monitored status of the cruise control switch. A closed switch is displayed as ON.
Cruise Control Resume/ Accelerate Switch	Cruise Control ON	Active/Inactive/Invalid	This parameter displays ON, when the cruise ON/OFF switch is ON and the resume switch is pressed, the ECM detects a predetermined voltage value for the resume switch.
Cruise Control Set/ Coast Switch	Cruise Control ON	Active/Inactive/Invalid	This parameter displays ON, when the cruise ON/OFF switch is ON and the ECM detects a predetermined voltage value for the set switch.
Distance Since DTC Cleared	—	Varies	This parameter displays the distance accumulated since an emission diagnostic trouble code was cleared. The scan tool will display increasing distance as the vehicle is driven.
Distance Since First Malfunction	Vehicle ON	0 km/h (0 MPH)	This parameter displays in kilometers or miles the distance traveled since a Malfunction occurred.
Distance Since Last Malfunction	—	Varies	This parameter displays the distance accumulated when the emission diagnostic trouble code last failed.
Driver Requested Axle Torque	—	Varies	This parameter displays the drivers requested axle torque as determined by the ECM. The ECM monitors accelerator pedal position and determines how much axle torque is required in order to meet the drivers request. The parameter display range is −8192 to +8191.75 N•m
ECM Authentication Status	Vehicle ON	Unknown/Incorrect /Negative Response/ Valid	This parameter displays the ECM Authentication Status result of the comparison between the last received immobilizer response and the expected response calculated into the ECM.
ECM Response Source	Vehicle ON	Ignition Switch Start/ Remote Vehicle Start/ Exterior Power Take Off (PTO) Vehicle Start	This parameter displays the ECM Response Source used to calculate the ECM response.

ECM Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Description
Extended Travel Brake Pedal Position Signal	Applied/Released/ Invalid	Released	This parameter displays the brake pedal travel beyond a moderate/extended travel threshold by the platform brake sensing module and is received over serial data.
Hood Position	Open/Closed	Closed	This parameter displays the status of the hood latch switch as determined by the ECM.
Ignition Input Accessory	Active/Inactive		This parameter displays the voltage of the accessory feed circuit of the hybrid powertrain control module. The parameter display range is 0–65.535V.
Ignition Input Off/On/ Start	Active/Inactive	Active	This parameter displays the voltage of the ignition feed circuit of the hybrid powertrain control module. The parameter display range is 0–65.535V.
Ignition 1 Signal	Volts	Varies	This parameter displays the voltage of the ignition feed circuit of the ECM.
Immobilizer Auto Learn Counter	Counts	Varies	This indicates the number of autolearn cycles that have been successfully completed within the immobilizer system.
Immobilizer Automatic Learn Timer	hh:mm:ss	Varies	This indicates the time elapsed within the current autolearn cycle within the immobilizer system.
Immobilizer Password Learn	—	Yes	This parameter displays Yes when a valid theft password has been learned.
Immobilizer Security Code Accepted	Yes/No	Yes	This parameter displays that the Security Code Accepted received is correct.
Immobilizer Security Code Lockout	Active/Inactive	Inactive	This parameter displays the Security Code Lockout Active has not passed and lockout is active.
Immobilizer Security Code Lockout Timer	ms	Varies	This parameter displays the time elapsed since the receipt of the correct security code within the immobilizer system.
Immobilizer Security Code Programmed	—	Yes	This parameter displays if the immobilizer system security code has been programmed.
Immobilizer Security Code Programming Counter	Counts	Varies	This parameter displays the number of times a new immobilizer security code has been programmed through secure access. This counter can only be incremented.
Immobilizer Security Information Programmed	Yes/No	Yes	This parameter displays that the immobilizer key has been programmed.
Immobilizer System Status	—	Varies	This parameter displays the current state of the immobilizer System Status. The states include the following: Standby, Disabled at Startup, Disabled Due to No Response, Disabled Due to Negative Response, Disabled Due to Incorrect Response, Post Release, Pre-Release, Released.
Internal Mode Switch	Park, Reverse, Neutral, Drive, Low, Invalid	Park	This switch indicates transmission range. This is a contact switch attached to the control valve body within the transmission. The 9 outputs from the switch indicate which position is selected by the transmission manual shaft.
Internal Mode Switch A/ B/C/P	High/Low	Low/High/High/Low	This displays the position of each internal mode switch state. A/B/C/P are identification for the 4 switches.
Low-Voltage Circuit Enable Command	—	Yes	Indicates if the low voltage circuit is enabled.

ECM Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Description
MIL Command	Vehicle ON	ON/OFF	This parameter displays the commanded state of the malfunction indicator lamp (MIL) control circuit by the engine control module (ECM).
MIL Control Circuit High Voltage Test Status	—	OK	This parameter displays the status of the control circuit for the malfunction indicator lamp (MIL) control. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit malfunctions are detected during the current test.
MIL Control Circuit Low Voltage Test Status	—	OK	This parameter displays the status of the control circuit for the malfunction indicator lamp (MIL) control. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit malfunctions are detected during the current test.
MIL Control Circuit Open Test Status	—	OK	This parameter displays the status of the control circuit for the malfunction indicator lamp (MIL) control. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit malfunctions are detected during the current test.
MIL Requested by DTC	Vehicle ON	Yes/No	This parameter displays the reason the engine control module illuminated the MIL. The scan tool will display Yes when the MIL is requested as a result of an A or B type DTC. The scan tool will display No if the MIL is illuminated for another reason, such as transmission DTCs.
Power Mode	Vehicle ON	OFF/Accessory/Run /Crank Request	This Parameter displays the state of the System Power Mode. This signal is based upon the state of the system power mode received over serial communication from the vehicle electronics. If the serial data signal not received, the Parameter will display OFF.
Remote Vehicle Start Disable History 1–8	—	Varies	This parameter indicates one of the last eight reasons the powertrain has disabled the remote vehicle start.
Remote Vehicle Start Request Signal	On/Off	On	This parameter indicates if the vehicle has been requested to On due to a remote start command.
Transmission Fluid Temperature	°C	Varies	This parameter displays the transmission fluid temperature as reported by the transmission fluid temperature sensor.
Vehicle Speed	—	0 km/h (0 MPH)	This parameter displays the speed of the vehicle as calculated by the transmission control module (TCM) from information received from the vehicle speed sensor.

ECM Scan Tool Output Controls

Control Function	Description
Active Grille Air Shutter Position	This test will be used to cycle the Air shutter from open to closed. Upon successfully closing a Pass/No Pass condition will be shown to the technician based on a Validity bit supplied by the ECM.
Malfunction Indicator Lamp (MIL)	This function controls the malfunction indicator lamp (MIL). The normal commanded state is None. When commanded ON or OFF, the ECM turns the malfunction indicator lamp (MIL) ON or OFF. This output can also be monitored on the scan tool data parameter MIL Command. The system remains in the commanded state until cancelled by the scan tool.
14V Power Module Setpoint	This function controls the target output the 14V Power Module will try to maintain.

Battery Energy Control Module Scan Tool Information

Battery Energy Control Module Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Control Module Voltage Signal	Volts	Displays the voltage that is currently available for the control module to function. A typical values will be whatever the current available battery voltage is (12–14 V).
5V Reference 1	Volts	The reference voltage is a fixed voltage that is provided by the control module to various sensors. This voltage is then used by the various sensors to produce a feedback signal to the electronic control module.
5V Reference 2	Volts	This parameter will display the current voltage available on the 5 V reference 2 circuit. (0–5 V). The reference voltage is a fixed voltage that is provided by the control module to various sensors.
System Power Mode	Off/ Accessory/ Run/ Crank Request	Display the status of the ignition switch on/off. The ignition switch allows the driver to control the power to the accessories. This switch also connects the starter to the battery.
Hybrid/EV Battery Pack Low Resolution Current Sensor	Amps	A sensor that measures Hybrid/EV Battery pack current. There are 2 current sensors that measure total battery pack current. One is a low resolution and one is a high resolution.
Hybrid/EV Battery Pack High Resolution Current Sensor	Amps	A sensor that measures Hybrid/EV Battery pack current. There are 2 current sensors that measure total battery pack current. One is a low resolution and one is a high resolution.
Hybrid/EV Battery Pack Terminal 1 Voltage	Volts	Hybrid/EV Battery DC Voltage Sensor 1 represents the Hybrid/EV Battery pack voltage as measured at the Battery side of the high voltage contactors.

Hybrid/EV Battery Interface Control Module Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Hybrid/EV Battery Interface Control Module 1 Cell Overvoltage	Degrees C	Hybrid/EV Battery Temperature Sensor 1 represents the temperature within Battery Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery Interface Control Module 2 Cell Overvoltage	Degrees C	Hybrid/EV Battery Temperature Sensor 2 represents the temperature within Battery Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery Interface Control Module 3 Cell Overvoltage	Degrees C	Hybrid/EV Battery Temperature Sensor 3 represents the temperature within Battery Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery Interface Control Module 4 Cell Overvoltage	Degrees C	Hybrid/EV Battery Temperature Sensor 4 represents the temperature within Battery Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery Interface Control Module 5 Cell Overvoltage	Degrees C	Hybrid/EV Battery Temperature Sensor 5 represents the temperature within Battery Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery Interface Control Module 6 Cell Overvoltage	Degrees C	Hybrid/EV Battery Temperature Sensor 6 represents the temperature within Battery Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery Interface Control Module 7 Cell Overvoltage	Degrees C	Hybrid/EV Battery Temperature Sensor 7 represents the temperature within Battery Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery Interface Control Module 8 Cell Overvoltage	Degrees C	Hybrid/EV Battery Temperature Sensor 8 represents the temperature within Battery Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.

Hybrid/EV Battery Interface Control Module Scan Tool Data Parameters (cont'd)

Parameter	Expected Value	Definition
Hybrid/EV Battery Interface Control Module 9 Cell Overvoltage	Degrees C	Hybrid/EV Battery Temperature Sensor 9 represents the temperature within Battery Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.

Temperature Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Hybrid/EV Battery 1	Degrees C	Hybrid/EV Battery Temperature Sensor 2 represents the temperature within Battery Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 2	Degrees C	Hybrid/EV Battery Temperature Sensor 3 represents the temperature within Battery Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 3	Degrees C	Hybrid/EV Battery Temperature Sensor 6 represents the temperature within Battery Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 4	Degrees C	Hybrid/EV Battery Temperature Sensor 7 represents the temperature within Battery Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 5	Degrees C	Hybrid/EV Battery Temperature Sensor 10 represents the temperature within Battery Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 6	Degrees C	Hybrid/EV Battery Temperature Sensor 11 represents the temperature within Battery Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 7	Degrees C	Hybrid/EV Battery Temperature Sensor 14 represents the temperature within Battery Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 8	Degrees C	Hybrid/EV Battery Temperature Sensor 15 represents the temperature within Battery Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery Pack Coolant Temperature Sensor 1	Degrees C	The Hybrid/EV Battery pack coolant temperature measured at the coolant loop inlet of the Hybrid/EV Battery pack.
Hybrid/EV Battery Pack Coolant Temperature Sensor 2	Degrees C	The Hybrid/EV Battery pack coolant temperature measured at the coolant loop outlet of the Hybrid/EV Battery pack.

Voltage Data 1 Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Hybrid/EV Battery 1	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 1 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 2	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 2 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 3	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 3 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 4	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 4 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.

Voltage Data 1 Scan Tool Data Parameters (cont'd)

Parameter	Expected Value	Definition
Hybrid/EV Battery 5	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 5 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 6	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 6 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 7	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 7 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 8	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 8 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 9	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 9 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 10	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 10 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 11	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 11 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 12	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 12 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 13	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 13 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 14	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 14 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 15	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 15 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.

Voltage Data 2 Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Hybrid/EV Battery 16	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 16 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 17	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 17 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 18	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 18 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.

Voltage Data 2 Scan Tool Data Parameters (cont'd)

Parameter	Expected Value	Definition
Hybrid/EV Battery 19	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 19 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 20	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 20 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 21	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 21 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 22	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 22 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 23	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 23 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 24	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 24 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 25	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 25 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 26	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 26 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 27	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 27 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 28	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 28 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 29	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 29 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 30	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 30 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.

Voltage Data 3 Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Hybrid/EV Battery 31	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 31 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 32	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 32 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.

Voltage Data 3 Scan Tool Data Parameters (cont'd)

Parameter	Expected Value	Definition
Hybrid/EV Battery 33	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 33 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 34	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 34 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 35	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 35 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 36	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 36 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 37	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 37 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 38	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 38 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 39	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 39 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 40	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 40 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 41	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 41 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 42	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 42 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 43	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 43 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 44	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 44 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 45	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 45 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.

Voltage Data 4 Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Hybrid/EV Battery 46	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 46 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.

Voltage Data 4 Scan Tool Data Parameters (cont'd)

Parameter	Expected Value	Definition
Hybrid/EV Battery 47	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 47 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 48	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 48 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 49	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 49 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 50	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 50 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 51	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 51 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 52	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 52 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 53	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 53 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 54	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 54 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 55	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 55 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 56	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 56 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 57	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 57 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 58	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 58 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 59	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 59 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 60	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 60 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.

Voltage Data 5 Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Hybrid/EV Battery 61	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 61 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 62	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 62 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 63	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 63 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 64	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 64 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 65	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 65 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 66	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 66 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 67	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 67 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 68	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 68 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 69	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 69 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 70	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 70 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 71	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 71 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 72	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 72 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 73	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 73 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 74	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 74 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 75	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 75 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.

Voltage Data 6 Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Hybrid/EV Battery 76	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 76 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 77	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 77 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 78	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 78 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 79	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 79 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 80	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 80 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 81	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 81 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 82	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 82 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 83	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 83 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 84	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 84 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 85	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 85 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 86	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 86 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 87	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 87 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 88	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 88 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 89	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 89 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 90	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 90 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.

Voltage Data 7 Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Hybrid/EV Battery 91	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 91 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 92	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 92 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 93	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 93 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 94	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 94 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 95	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 95 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 96	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 96 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 97	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 97 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 98	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 98 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 99	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 99 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 100	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 100 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 101	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 101 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 102	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 103 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 104	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 104 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 105	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 105 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.

Voltage Data 8 Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Hybrid/EV Battery 106	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 106 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 107	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 107 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 108	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 108 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 109	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 109 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 110	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 110 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 111	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 111 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 112	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 112 within Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.

Hybrid Powertrain Control Module Scan Tool Information

The hybrid powertrain control module is a non-serviceable module within the power inverter module, often referred to as the drive motor generator power inverter module assembly. The Hybrid Powertrain Control Module Scan Tool Data Parameters list contains hybrid controls-related parameters. The list is arranged in alphabetical order. A given parameter may appear in any one of the data lists, and in some cases may appear more than once, or in more than one data list in order to group certain related parameters together.

Use the Hybrid Powertrain Control Module Scan Tool Data Parameters list only after the following is determined:

- The *Diagnostic System Check - Vehicle on page 6-91* is completed.
- No diagnostic trouble codes (DTCs)
- On-board diagnostics are functioning properly

The scan tool values from a properly running vehicle may be used for comparison with the vehicle you are diagnosing. The Hybrid Powertrain Control Module Scan Tool Data Parameters list represents values that would be seen on a normally running vehicle.

Note: A scan tool that displays faulty data should not be used. The scan tool concern should be reported to the manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.

Only the parameters listed below are referenced in this service manual for use in diagnosis. If all values are within the typical range described below, refer to *Symptoms - Hybrid Controls on page 9-167* for diagnosis.

Hybrid Powertrain Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Vehicle ON/Closed Throttle/Park or Neutral/Accessories OFF, unless otherwise noted			
14V High Voltage Circuit Current	—	Varies	This parameter displays the high voltage circuit current as determined by the accessory dc power control module. The parameter display range is −1638.4 to +1638.35 Amps.

Hybrid Powertrain Control Module Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Description
14V Power Module Power Loss	—	Varies	The accessory DC power module converts high voltage (300V) direct current (DC) to low voltage (12V) DC for accessory electrical operation and to charge the 12 volt battery. This parameter indicates the difference in power (power loss) between the input power and the output power of the Accessory Power Module. The power loss is determined based upon High Voltage current and voltage, Low Voltage current and voltage, and Intermediate Voltage current and voltage measurements from the accessory power module internal sensors.
14V Power Module Status	—	Normal	The accessory power module converts high voltage (300V DC) to low voltage (12V DC) for accessory electrical operation and to charge the 12 volt battery. This parameter contains the control status of the accessory DC power module.
14V Power Module Temperature Sensor 1	—	Varies	This parameter displays the value received from temperature sensor 1 in the 14V Power Module.
14V Power Module Temperature Sensor 2	—	Varies	This parameter displays the value received from temperature sensor 2 in the 14V Power Module.
A/C Auto Air Recirculation	—	Varies	Air Conditioning Recirculation State - On or Off
A/C Compressor Clutch Relay Command	—	Varies	Air Conditioning Compressor State - On or Off
A/C Compressor Power Consumption	—	Varies	This parameter contains the Air Conditioning Compressor Electric Power which represents the actual A/C compressor electric power as reported by the accessory DC power control module to the hybrid powertrain control module and the ECM.
A/C Compressor Power Limit	—	Varies	This parameter contains the Air Conditioning Compressor Power Limit which represents the amount of power the hybrid powertrain control module allows the accessory DC power control module to use to run the compressor.
A/C Compressor Power Limit Rate of Change	—	Varies	This parameter contains the Air Conditioning Compressor Power Gradient which represents the power gradient the hybrid powertrain control module allows the accessory DC power control module to use to run the compressor.
A/C Disable - A/C Pressure Out of Range	—	Varies	Air Conditioning Compressor Pressure Disable - Yes or No

Hybrid Powertrain Control Module Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Description
A/C Disengage History 1	—	None	The air conditioning (A/C) compressor may be disengaged by the ECM (Engine Control Module) for many reasons. These reasons are recorded by the A/C Disengage History parameters 1-8.
A/C Disengage History 2	—	None	
A/C Disengage History 3	—	None	
A/C Disengage History 4	—	None	
A/C Disengage History 5	—	None	
A/C Disengage History 6	—	None	
A/C Disengage History 7	—	None	
A/C Disengage History 8	—	None	
A/C High Side Pressure Switch	—	Varies	Displays the status of the A/C high side pressure switch.
A/C Low Side Pressure Switch	—	Varies	Displays the status of the A/C low side pressure switch.
A/C off for WOT	—	No	Air Conditioning Compressor Wide Open Throttle Disable.
A/C Request Signal	—	Varies	Air Conditioning Request On
Auxiliary Transmission Fluid Pump	—	Varies	This parameter displays the actual speed of the auxiliary transmission fluid pump in revolutions per minute.
Auxiliary Transmission Fluid Pump	—	Varies	This parameter contains the torque value, in N•m, for the auxiliary transmission fluid pump motor.
Auxiliary Transmission Fluid Pump Command	—	Varies	This parameter displays the commanded torque value for the auxiliary transmission fluid pump.
Auxiliary Transmission Fluid Pump Current	—	Varies	This parameter indicates the DC current consumed by the auxiliary transmission fluid pump motor.
Auxiliary Transmission Fluid Pump Inverter DC Voltage	—	Varies	This indicates the voltage on the DC bus at the auxiliary transmission fluid pump inverter.
Auxiliary Transmission Fluid Pump Inverter Status	—	Varies	This indicates the actual state of the auxiliary transmission fluid pump inverter.
Auxiliary Transmission Fluid Pump Temperature	—	Varies	This indicates the temperature of the auxiliary transmission fluid pump motor measured by a sensor.
Axle Torque	—	Varies	This parameter displays actual axle torque. The parameter display range is −8192 to +8191.75 N•m
Axle Torque Command	—	Varies	This parameter displays commanded axle torque. The parameter display range is −8192 to +8191.75 N•m
Axle Torque Immediate	—	Varies	This parameter displays the immediate axle torque required when accelerating. The parameter display range is −8192 to +8191.75 N•m
Brake Pedal Position Circuit Signal	—	No	Brake Pedal Apply Active indicates that the brake pedal apply input to the controller indicates that the brake is applied.

Hybrid Powertrain Control Module Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Description
Brake Pedal Position Sensor Learned Released Position	—	Yes	Brake Pedal Fully Released Position Learn Complete indicates that the brake pedal fully released position has been successfully learned.
Brake Pedal Position Sensor Signal	—	No	Indicates if the brake pedal is applied or released.
Calculated Line Pressure	—	Varies	This indicates the expected actual line pressure after accounting for pump loss factors.
Calculated Line Pressure	—	Varies	This indicates the calculated transmission fluid line pressure.
Calculated Throttle Position	Pedal Released	0%	This parameter displays the position of the accelerator pedal as determined by the ECM. This parameter is not active when the transmission is in Park or Neutral. 100% is displayed when the pedal is fully depressed. The parameter display range is 0–100%.
	Pedal Fully Depressed	100%	
Contactor Open reason History 1	—	Varies	Displays the reason the high voltage contactors were commanded open.
Contactor Open reason History 2	—	Varies	Displays the reason the high voltage contactors were commanded open.
Contactor Open reason History 3	—	Varies	Displays the reason the high voltage contactors were commanded open.
Contactor Open reason History 4	—	Varies	Displays the reason the high voltage contactors were commanded open.
Contactor Open reason History 5	—	Varies	Displays the reason the high voltage contactors were commanded open.
Contactor Open reason History 6	—	Varies	Displays the reason the high voltage contactors were commanded open.
Contactor Open reason History 7	—	Varies	Displays the reason the high voltage contactors were commanded open.
Contactor Open reason History 8	—	Varies	Displays the reason the high voltage contactors were commanded open.
Continuous Charge Mode Command	—	Varies	Indicates if the continuous charge node is active.
Drive Motor Current	—	Varies	Indicates current being consumed by the drive motor.
Drive Motor Inverter Status	—	Varies	This indicates the actual state of the drive motor inverter.
Drive Motor Inverter Supply Voltage	—	Varies	This indicates the voltage available to the drive motor inverter.
Drive Motor Speed	—	Varies	This indicates the actual drive motor speed.
Drive Motor Torque	—	Varies	This indicates the calculated torque output value for the drive motor
Driver Requested Axle Torque	—	No	This parameter displays the drivers request for axle torque.
ECM Challenge Status	—	Varies	Indicates if the engine control module has sent out a request to the immobilizer module to reply with a password.
Extended Travel Brake Pedal Position Signal	—	Varies	Indicates the brake pedal travel beyond a moderate / extended travel threshold by the platform brake sensing module and is received over serial data.
Extended Travel Brake Pedal Switch	—	Varies	Indicates the state of the extended travel brake switch input to the ECM.

Hybrid Powertrain Control Module Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Description
Hybrid/EV Battery Pack Current	—	Varies	This parameter displays the actual current flow of the high voltage (300V) electrical system as determined by the Hybrid Powertrain Control Module 2. The parameter display range is −1638.4 to +1638.35 Amps. A negative current value indicates a battery charge while a positive current value indicates a battery discharge.
Hybrid/EV Battery Pack State of Charge	—	Varies	This parameter displays the state of charge of the battery pack as determined by the Hybrid Powertrain Control Module 2. The parameter display range is 0–100%.
Hybrid Powertrain Control Module Authentication Status	—	Varies	This indicates the result of the comparison between the last received immobilizer system response and the expected response calculated by the hybrid powertrain control module.
Hybrid Powertrain Control Module High Voltage Circuit	—	Varies	This displays the high voltage circuit voltage as detected by the hybrid powertrain control module which detects voltage in a range from 0–655.35 V.
Hybrid Powertrain Control Module Response Source	—	Varies	This will match the ECM parameter and indicates the source used to calculate the hybrid powertrain control module response. The sources include Normal Start, Remote Vehicle Start, PTO Remote Start.
Ignition 1 Signal	—	Varies	This parameter displays the voltage of the ignition feed circuit of the hybrid powertrain control module.
Immobilizer Auto Learn Counter	—	Varies	This indicates the number of autolearn cycles that have been successfully completed within the immobilizer system.
Immobilizer Automatic Learn Timer	—	Varies	This indicates the time elapsed within the current autolearn cycle within the immobilizer system.
Immobilizer Password Learn	—	Varies	The vehicle theft deterrent (VTD) module must be put in a learn mode to learn the correct password when the module is replaced.
Immobilizer Password Learn Scan Tool Delay	—	Varies	Tool Learn Delay Active indicates that the security code has been accepted but the tool learn delay is active and will not allow learning enabled, programming security code, or resetting security code.
Immobilizer Security Code Accepted	—	Varies	Security Code Accepted indicates that the received security code is correct.
Immobilizer Security Code Lockout	—	Varies	Security Code Lockout Active indicates that the security code has not passed and lockout is active.
Immobilizer Security Code Programmed	—	Varies	Indicates that the security code has been programmed.
Immobilizer Security Code Programming Counter	—	Varies	Indicates the number of times a new immobilizer security code has been programmed through secure access. This counter can only be incremented.
Immobilizer Security Code Reset Counter	—	Varies	Indicates the number of times the immobilizer security code has been reset to the default value through secure access. This counter can only be incremented.
Immobilizer Security Information Programmed	—	Varies	This indicates that the immobilizer key has been programmed.

Hybrid Powertrain Control Module Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Description
Immobilizer System Status	—	Varies	Indicates the current state of the immobilizer algorithm.
Internal Mode Switch Range	—	Park or Neutral	This parameter displays the vehicle direction selected as determined by the manual shift shaft position switch, also referred to as the internal mode switch. The internal mode switch contains two discrete shift lever-actuated switch patterns. The internal mode switch range switch pattern is monitored by the TCM and is utilized to determine gear range as selected by the shift lever. The internal mode switch direction switch pattern is monitored by the hybrid powertrain control module and is utilized to determine vehicle direction and the Park/Neutral start safety condition as selected by the shift lever. The parameter display range is Park, Reverse, Neutral, Drive , Transition, Invalid and Illegal Setting.
Internal Mode Switch 2	—	Hi/Low	Indicates the status of the transmission Internal Mode Switch direction contacts.
Internal Mode Switch 2 - D1	—	Hi/Low	Indicates the status of the transmission Internal Mode Switch direction contacts.
Internal Mode Switch 2 - D2	—	Hi/Low	Indicates the status of the transmission Internal Mode Switch direction contacts.
Internal Mode Switch 2 - R1	—	Hi/Low	Indicates the status of the transmission Internal Mode Switch direction contacts.
Internal Mode Switch 2 - R2	—	Hi/Low	Indicates the status of the transmission Internal Mode Switch direction contacts.
Internal Mode Switch 2 -S	—	Hi/Low	Indicates the status of the transmission Internal Mode Switch direction contacts.
Low Voltage Circuit Current	—	Varies	Displays the value low voltage (12 V) circuit current as detected by the accessory DC power control module.
Low Voltage Circuit Voltage	—	Varies	Displays the value low voltage (12 V) circuit as detected by the accessory DC power control module.
Maximum Hybrid/EV Battery Module Temperature	—	Varies	Indicates the temperature of the hybrid battery module with the highest temperature.
Minimum Hybrid/EV Battery Module Temperature	—	Varies	Indicates the temperature of the hybrid battery module with the lowest temperature.
Output Shaft Direction	—	Varies	Indicates the direction of a transmission output shaft rotation.
Power Mode	—	Varies	Displays system power mode status as determined by ignition switch inputs to the power mode master. System power mode status should match the ignition switch position.
Regenerative Braking Axle Torque Request	—	Varies	Indicates the Regenerative Braking Axle Torque Request value sent from the anti lock brake module to the hybrid powertrain control module.
Regenerative Braking Torque Predicted	—	Varies	Indicates the Regenerative Braking Axle Torque Request value sent from the anti lock brake module to the hybrid powertrain control module.

Hybrid Powertrain Control Module Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Description
Security Code Lockout Active Timer	—	Varies	Indicates the time elapsed since the immobilizer security code lockout has been activated either due to a battery disconnect or an incorrect immobilizer security code being entered.
Torque Delivered Signal	—	Varies	Indicates engine steady state torque
Torque Delivered Signal	—	Varies	This indicates the actual drive motor torque delivered.
Total Brake Torque	—	Varies	Indicates the actual state of blended regenerative braking as determined by the hybrid control module.
Transmission Fluid Temperature	—	Varies	Indicates that the last autostart was triggered due to transmission temperature out of range.
Transmission OSS	—	Varies	Transmission Output Speed.
Transmission Torque Command	—	Varies	Indicates the commanded transmission output torque.
Vehicle Speed Sensor	—	Varies	Indicates vehicle speed calculated from the transmission output speed.
VIN Programming Counter	—	Varies	Indicates the number of times the VIN has been programmed. This counter can only be incremented.

Hybrid Powertrain Control Module Scan Tool Output Controls

Output Control	Description
Aux. Trans. Pump Speed	• The hybrid powertrain control module commands the auxiliary transmission fluid pump control module to turn the auxiliary pump ON and OFF. Additionally, the hybrid powertrain control module commands the auxiliary pump to operate at a certain speed (RPM). • When operating the Auxiliary Transmission Oil Pump Speed control, the following control limits apply: – The internal combustion engine (ICE) must be OFF. – Electric motor speed must be 0 RPM.
Check High Voltage System Related DTCs	Indicates if any high voltage system related DTCs are present.
Clear Secured High Voltage DTC	**Note:** Perform the high voltage disable procedure and repair or replace damaged high voltage components as specified in the applicable diagnostic prior using this control. • The hybrid powertrain control module monitors for a high voltage present condition after the high voltage contactor relays have been opened. When high voltage is present this DTC will set. • The hybrid powertrain control module clears the DTC Information for the high voltage present DTC . • The following control limits apply: – Vehicle must be ON. – The hybrid powertrain control module must monitor that high voltage is not currently present. – Communication DTCs must not be present. – Turn the vehicle OFF and wait 5 minutes after performing this Output Control.
Regenerative Braking	• The hybrid powertrain control module will enable or disable blended regenerative braking. • When the vehicle is ON there are no limits to this control.

Hybrid Powertrain Control Module 2 Scan Tool Information

Charge History Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: The Charge History parameters capture the conditions present during the last five alternating current (AC) charge events. A charge event is recorded whenever the charge coupler is fully mated to the charge receptacle. History 1 is the most recent charge event. The Charge History parameters are cleared only during an HPCM2 replacement and/or programming event.		
Charge History (1 thru 5) – 110V AC Input	Varies	This parameter displays if the 110V charge cord was active during this charge event.
Charge History (1 thru 5) – 240V AC Input	Varies	This parameter displays if the 240V charge cord was active during this charge event.
Charge History (1 thru 5) – Autostart Inhibit	Varies	This parameter displays if the charge event was interrupted because of an engine start. An engine start could be commanded via remote start, key crank, cold battery, etc.
Charge History (1 thru 5) – Battery Charger Temperature Too High	No	This parameter displays if the charge event was interrupted because the Battery Charger internal temperature exceeded a set value. Refer to DTC P1EF3–P1EF5.
Charge History (1 thru 5) – Charging Cord Error	No	This parameter displays if the vehicle battery charger is requesting utility power but AC input voltage is not present. Refer to DTC P1EE6.
Charge History (1 thru 5) – Contactor Open	No	This parameter displays if the charging related contactor(s) were commanded open, interrupting the charge event.
Charge History (1 thru 5) – Full Charge	Varies	This parameter displays if the high voltage battery was completely charged during this charge event.
Charge History (1 thru 5) – High Severity Fault	No	This parameter displays if high voltage battery DTCs such as cell overvoltage had set, inhibiting the charge event.
Charge History (1 thru 5) – Hybrid/EV Battery Pack Protection	No	This parameter displays if high voltage battery DTCs had set, inhibiting the charge event.
Charge History (1 thru 5) – Hybrid/EV Battery Pack Temperature Too Low	No	This parameter displays if the charge event was interrupted because the high voltage battery temperature was too low to allow charging.
Charge History (1 thru 5) – Low Severity Fault	No	This parameter displays if high voltage battery DTCs had set, interrupting the charge event.
Charge History (1 thru 5) – Low Voltage – Battery Voltage Low Before Charge	No	This parameter displays if the 12 V accessory battery voltage was too low prior to the charging event being enabled.
Charge History (1 thru 5) – Low Voltage – Battery Voltage Low During Charge	No	This parameter displays if the 12V accessory battery voltage was too low during the charge event.
Charge History (1 thru 5) – Maximum Cell Voltage	No	This parameter displays if the maximum voltage for one of the high voltage battery cells was exceeded, interrupting the charge event.
Charge History (1 thru 5) – Maximum Charge Time Exceeded	No	This parameter displays if the maximum charge time was exceeded during this charge event. Maximum charge time varies by vehicle model with 40 hours being the shortest maximum allowed charge time.
Charge History (1 thru 5) – Medium Severity Fault	No	This parameter displays if high voltage battery DTCs had set, interrupting the charge event.
Charge History (1 thru 5) – Multiple Plug–In Events Within 30 Seconds	No	This parameter displays if that several charge cord connections/disconnections were observed at the charger receptacle in a 30 second time frame.
Charge History (1 thru 5) – Multiple Plug–In Events Within 5 Minutes	No	This parameter displays if that several charge cord connections/disconnections were observed at the charger receptacle in a 5 minute time frame.
Charge History (1 thru 5) – Time of Day Inhibit	Varies	This parameter displays if programmable charging (time of day/rate based) had delayed charging at some point during this event.
Charge History (1 thru 5) – Unplugged at Vehicle	Varies	This parameter displays if the charge event was interrupted because the charge cord was disconnected at the vehicle charge receptacle.

Charge History Scan Tool Data Parameters (cont'd)

Parameter	Expected Value	Definition
Charge History (1 thru 5) – Unplugged at Wall	Varies	This parameter displays if the charge event was interrupted when AC voltage was lost to the charge cord. Most likely this occurred by either the charge cord plug being removed from the household receptacle or a household utility circuit breaker tripping open.
Charge History (1 thru 5) – Utility Company Inhibit	Varies	This parameter displays if smart charging had delayed charging at some point during this charge event due to a utility company commanded transmitted via Onstar.
Charge History (1 thru 5) – Vehicle Conditions Not Correct	Yes	This parameter displays if the required vehicle conditions to allow charging such as gear selector in Park, valid charger pilot signal have been met.

DC Charge History Scan Tool Data Parameters (w/CBT)

Parameter	Expected Value	Definition
Operating Conditions: The DC Charge History parameters capture the conditions present during the last five fast charge events. A fast charge event is recorded whenever the charge coupler is fully mated to the charge receptacle. History 1 is the most recent charge event. The DC Charge History parameters are cleared only during an HPCM2 replacement and/or programming event.		
DC Charge History (1 thru 5) – Active Cooling and Charging Enabled	Varies	This parameter displays if active cooling was active during this charge event. The electric A/C compressor will be turned ON and the coolant control valve will be set to the chiller position allowing the air conditioning refrigerant to cool the hybrid/EV battery coolant.
DC Charge History (1 thru 5) – Active Cooling Enabled	Varies	This parameter displays if active cooling was active. The electric A/C compressor will be turned ON and the coolant control valve will be set to the chiller position allowing the air conditioning refrigerant to cool the hybrid/EV battery coolant.
DC Charge History (1 thru 5) – Active Heating and Charging Enabled	Varies	This parameter displays if active heating was active during this charge event. The electric battery heater will be turned ON allowing the heated coolant to warm the hybrid/EV battery.
DC Charge History (1 thru 5) – Bulk Charge Complete	Varies	This parameter displays if the high voltage battery was almost completely charged.
DC Charge History (1 thru 5) – Charge Contactors Allowed to Close	Varies	This parameter displays if the DC Charge Contactors closed.
DC Charge History (1 thru 5) – Charge High Voltage Output Active	Varies	This parameter displays if the DC charge contactors are closed.
DC Charge History (1 thru 5) – Charge Receptacle Overtemperature	No	This parameter displays if the system has commanded the DC Charge contactors open to protect the charge receptacle from overheating.
DC Charge History (1 thru 5) – Charge Station Pilot Duty Cycle Not 5%	No	This parameter displays if a valid Pilot signal was not received.
DC Charge History (1 thru 5) – Charge System Integrity Not Verified	No	This parameter displays if the DC Charge system integrity was not verified.
DC Charge History (1 thru 5) – Charge System Integrity Verified	Yes	This parameter displays if the DC Charge system integrity was verified.
DC Charge History (1 thru 5) – Charger Functions Available	Yes	This parameter displays if the DC Charger functions are available.
DC Charge History (1 thru 5) – Charger Functions Unavailable	No	This parameter displays if the DC Charger functions are not available.
DC Charge History (1 thru 5) – Charging Conditions Correct	Varies	This parameter displays if the required vehicle conditions to allow charging such as gear selector in Park, valid charger pilot signal have been met.
DC Charge History (1 thru 5) – Charging Conditions Not Correct	Varies	This parameter displays if the required vehicle conditions to allow charging such as gear selector in Park, valid charger pilot signal have not been met.

DC Charge History Scan Tool Data Parameters (w/CBT) (cont'd)

Parameter	Expected Value	Definition
DC Charge History (1 thru 5) – Charging Enabled	Varies	This parameter displays if DC charging was enabled.
DC Charge History (1 thru 5) – Charging Stopped By Charge Station	Varies	This parameter displays if DC charging was interrupted by the off-vehicle charge station.
DC Charge History (1 thru 5) – Charging Stopped by Cordset	Varies	This parameter displays if DC charging was interrupted by the Cordset.
DC Charge History (1 thru 5) – Contactor Open Request	Varies	This parameter displays if the charging related contactor(s) were commanded open, interrupting the charge event.
DC Charge History (1 thru 5) – Cordset Correct for Charging	Yes	This parameter displays if the correct cordset was connected to the vehicle.
DC Charge History (1 thru 5) – DC Charge Current Reduced for Battery Protection	No	This parameter displays if the DC charge level was reduced to protect the Hybrid/EV battery during certain conditions such as the temperature too high.
DC Charge History (1 thru 5) – DC Enabled Since Plug-In	Varies	This parameter displays if DC charging was enabled since the cordset was plugged in.
DC Charge History (1 thru 5) – DC Not Provided	No	This parameter displays if DC voltage was not provided by the off-vehicle charge station.
DC Charge History (1 thru 5) – Full Charge	Varies	This parameter displays if the high voltage battery was completely charged.
DC Charge History (1 thru 5) – High Severity Fault	No	This parameter displays if high voltage battery DTCs such as cell overvoltage had set, inhibiting the charge event.
DC Charge History (1 thru 5) – Hybrid/EV Battery Pack Protection	No	This parameter displays if the DC charge was disabled to protect the Hybrid/EV battery during certain conditions such as the temperature too high.
DC Charge History (1 thru 5) – Hybrid/EV Battery Pack Temperature Too High	Varies	This parameter displays if the charge event was interrupted because the high voltage battery temperature was too high to allow charging.
DC Charge History (1 thru 5) – Hybrid/EV Battery Pack Temperature Too Low	Varies	This parameter displays if the charge event was interrupted because the high voltage battery temperature was too low to allow charging.
DC Charge History (1 thru 5) – Insufficient Current from Charge Station	No	This parameter displays if the off-vehicle charge station did not provide sufficient current to allow charging.
DC Charge History (1 thru 5) – Lost Communication with DC Charging Control Module	No	This parameter displays if the hybrid powertrain control module 2 lost communication with the T24 Battery Charger module.
DC Charge History (1 thru 5) – Low Severity Fault	No	This parameter displays if high voltage battery DTCs had set, interrupting the charge event.
DC Charge History (1 thru 5) – Low Voltage Battery Low Before Charging	No	This parameter displays if the 12 V accessory battery voltage was too low prior to the charging event being enabled.
DC Charge History (1 thru 5) – Low Voltage Battery Low During Charging	No	This parameter displays if the 12 V accessory battery voltage was too low during the charge event.
DC Charge History (1 thru 5) – Maximum Cell Voltage	No	This parameter displays if the maximum voltage for one of the high voltage battery cells was exceeded, interrupting the charge event.
DC Charge History (1 thru 5) – Medium Severity Fault	No	This parameter displays if high voltage battery DTCs had set, interrupting the charge event.
DC Charge History (1 thru 5) – Multiple Plug-In Events Within 30 Seconds	No	This parameter displays if that several charge cord connections/disconnections were observed at the charger receptacle in a 30 second time frame.
DC Charge History (1 thru 5) – Multiple Plug-In Events Within 5 Minutes	Varies	This parameter displays if that several charge cord connections/disconnections were observed at the charger receptacle in a 5 minute time frame.
DC Charge History (1 thru 5) – Precharge Failure	No	This parameter displays if a precharge failure occurred, interrupting the charge event. Precharge occurs in the milliseconds prior to closing both the main bus contactors. By routing the high voltage through a resistor, precharge prevents voltage spikes from occurring whenever high voltage is enabled.

DC Charge History Scan Tool Data Parameters (w/CBT) (cont'd)

Parameter	Expected Value	Definition
DC Charge History (1 thru 5) – Propulsion System Active	Varies	This parameter displays if DC charging was inhibited because the propulsion system was active.
DC Charge History (1 thru 5) – Run/Crank Active	Varies	This parameter displays if the ignition power mode was in Run/Crank.
DC Charge History (1 thru 5) – Vehicle Conditions Correct For Charging	Yes	This parameter displays if the required vehicle conditions to allow charging such as gear selector in Park, valid charger pilot signal have been met.
DC Charge History (1 thru 5) – Vehicle Requested Current Below Charge Station Limits	Varies	This parameter displays if the off-vehicle charge station was unable to provide charge current as low as the vehicle requested.

Hybrid Powertrain Control Module 2 Configuration/Reset Functions

Output Control	Description
DC Charging Disable Reset	This reset function is used to reset a DC Charge Disabled condition.
EV Range Reset	This reset function is used to reset the learned EV Range displayed to the operator of the vehicle.
Hybrid/EV Battery Contactor Open Reasons Reset	This reset function is used to clear the contactor open reasons history.
Hybrid/EV Battery Pack Capacity Learn	This reset function is used to learn the hybrid/EV battery pack capacity whenever the HPCM2, the Hybrid/EV Battery pack or individual hybrid/EV battery sections are replaced. Refer to the *Hybrid/EV Battery Pack Capacity Learn on page 9-541* procedure in Hybrid/EV Energy Storage.
Hybrid/EV Battery Pack Charging Adaptive Learn Reset	This reset function is used to reset the learned adaptive charging limits.
Hybrid/EV Battery Pack Coolant Control Solenoid Valve Learn	This reset function is used to learn the end-stop positions of the coolant valve.
Hybrid/EV Battery Pack Data Reset	This reset function is used to reset certain engineering data parameters.

Hybrid Powertrain Control Module 2 Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Vehicle in Run			
14V Power Module Power Available From Hybrid/EV Battery Pack	—	Varies	This parameter displays the amount of electrical power in kW the Hybrid/EV battery pack can supply to the 14V Power Module.
A/C Compressor Power Limit	—	No	This parameter displays if the electric power available to the Electric A/C compressor motor is at its limit.
A/C Compressor Speed	—	Varies	This parameter displays the actual speed of the electric A/C compressor motor shaft.
A/C High Side Pressure Sensor	Compressor OFF	Equal to low side	This parameter displays the pressure of the A/C system high side pressure sensor.
	Compressor ON	Higher than low side	
A/C Low Side Pressure Sensor	Compressor OFF	Equal to high side	This parameter displays the pressure of the A/C system low side pressure sensor.
	Compressor ON	Lower than high side	
A/C Low Side Pressure Sensor	—	Varies	This parameter displays the voltage of the A/C system low side pressure sensor.
Airbag Deployed	—	No	This parameter displays if the contactors are commanded open because an air bag has deployed.
Ambient Air Temperature	—	Varies	This parameter displays the temperature of the air surrounding the vehicle.
Average Hybrid/EV Battery Pack Temperature	—	Varies	This parameter displays the average temperature for all of the Hybrid/EV battery pack module sensors.

Hybrid Powertrain Control Module 2 Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Description
Battery Charger High Output	—	Varies	This parameter displays the current in amps supplied by the Battery Charger Control Module to the high voltage battery.
Battery Charger High Output	—	Varies	This parameter displays the power in kW supplied by the Battery Charger Control Module to the Hybrid/EV battery pack.
Battery Charger High Output	—	Varies	This parameter displays the voltage supplied by the Battery Charger Control Module to the high voltage battery.
Battery Charger High Voltage Energy Output During Last Charge	—	Varies	This parameter displays the energy (kWh) the battery charger has delivered into the high voltage Hybrid/EV battery pack during the last charge event.
Battery Charger High Voltage Power Output Available	—	Varies	This parameter displays the maximum battery charger power output in kW available for Hybrid/EV battery pack charging.
Battery Charger Input	—	Varies	This parameter displays the current in amps monitored by the Battery Charger Control Module on the charge cord.
Battery Charger Input	—	Varies	This parameter displays the voltage monitored by the Battery Charger Control Module on the charge cord.
Battery Charger Input 120V AC	—	Varies	This parameter displays the battery charging system is connected to 120V AC.
Battery Charger Input 240V AC	—	Varies	This parameter displays the battery charging system is connected to 240V AC.
Battery Charger Low Output	—	Varies	This parameter displays the current in amps supplied by the Battery Charger Control Module to the 12V accessory battery.
Battery Charger Low Output	—	Varies	This parameter displays the power in kW supplied by the Battery Charger Control Module to the 12V accessory battery.
Battery Charger Low Output	—	Varies	This parameter displays the voltage supplied by the Battery Charger Control Module to the 12V accessory battery.
Battery Charger Power Input Available	—	Varies	This parameter displays the maximum power in kW available at the battery charger plug receptacle coming from the wall outlet/utility supply.
Battery Charger Temperature	—	Varies	This parameter displays the temperature of the Battery Charger Control Module internal temperature sensor.
Battery Charger Total Power Output Available	—	Varies	This parameter displays the maximum battery charger power output in watts available for low voltage battery and hybrid battery pack charging
Battery Charging System	—	OK	This parameter displays if the components that make up the charge system are allowing charging.
Battery Charging System Indicator Status	—	Varies	This parameter displays the status of the charging system indicator (LEDs/Bulbs/Icons) visible to the operator of the vehicle.
Battery Charging System Isolation Test Status	—	Passed	Vehicles equipped with high voltage storage and propulsion capability are designed with both the positive and negative high voltage circuits isolated from the vehicle chassis. This parameter displays the results obtained when the Hybrid/EV battery pack last performed an isolation diagnostic test on the battery charging system.

Hybrid Powertrain Control Module 2 Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Description
Battery Charging System Negative Contactor Command	In Charge Mode	Closed	This parameter displays the Hybrid Powertrain Control Module 2 Commanded state of the contactor (relay) on (-) side of the battery charging system.
	Not in Charge Mode	Open	
Battery Charging System Operating Conditions	—	OK	This parameter displays if the battery charging system operating conditions are allowing charging.
Battery Charging System Positive Contactor Command	In Charge Mode	Closed	This parameter displays the Hybrid Powertrain Control Module 2 Commanded state of the contactor (relay) on (+) side of the battery charging system.
	Not in Charge Mode	Open	
Battery Charging System Receptacle Switch	Charge Cord Installed	Active	This parameter displays the state of the switch at the receptacle where the charge cord plugs in.
	Charge cord unplugged	Inactive	
Charge Port Door	—	Varies	This parameter displays the state of the switch at the door where the charge cord plugs in.
Cooling Fan Motor Command	—	Varies	This parameter displays the commanded air flow in percent of the radiator coolant fan.
Crash Event Detected	—	No	This parameter displays if the contactors are commanded open due to a vehicle crash event being detected.
DC Charge Port Current	—	Varies	This parameter displays the amount of current flowing though the charge receptacle DC terminals.
DC Charge Port Lock Actuator Position Sensor	—	—	This parameter displays the voltage of the B281 lock actuator position sensor.
DC Charge Port Lock Position Sensor	—	—	This parameter displays the voltage of the B281 lock position sensor.
DC Charge Port Temperature	—	—	This parameter displays the temperature of the X98 Hybrid/EV Battery Charger Receptacle internal temperature sensor.
DC Negative Supply Isolation Voltage	—	—	This parameter indicates the T24 Battery Charger – DC isolation sensor circuit voltage for the DC charge negative (-) HV bus. The negative and positive isolation voltage parameters will shift in respect to each other if HV isolation to chassis decreases.
DC Positive Supply Isolation Voltage	—	—	This parameter indicates the T24 Battery Charger – DC isolation sensor circuit voltage for the DC charge positive (+) HV bus. The negative and positive isolation voltage parameters will shift in respect to each other if HV isolation to chassis decreases.
Discharging	—	No	This parameter displays if the system is inhibiting contactor closure because the high voltage system is currently in the process of discharging the capacitors on the high voltage bus. Discharging usually occurs immediately following opening of the high voltage contactors.
Distance Since DTC Cleared	—	Varies	This parameter displays the distance in miles or kilometers since OBD diagnostic trouble codes (DTCs) have been cleared using the service tool.
Distance With MIL On	—	Varies	This parameter displays the accumulated distance in miles or kilometers driven with the malfunction indicator lamp (MIL) on.
High Voltage Interlock Circuit Fault	—	No	This parameter displays if the contactors are commanded open because the high voltage interlock circuit is detected open or faulted.

Hybrid Powertrain Control Module 2 Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Description
High Voltage System Interlock Circuit	HV Enabled	Energized	The high voltage interlock circuit routes through several components and connectors to determine if access to high voltage components is being attempted. This parameter displays if the high voltage interlock circuit is currently monitoring for high voltage system integrity.
	HV Not Enabled	De-Energized	
High Voltage System Interlock Circuit Status	HV Enabled	Pass	The high voltage interlock circuit routes through several components and connectors to determine if access to high voltage components is being attempted. This parameter displays the results of the control modules diagnostic test of the high voltage interlock circuit.
	HV Not Enabled	Unknown	
High Voltage System Isolation Test Status	HV Enabled	Not Running	Vehicles equipped with high voltage storage and propulsion capability are designed with both the positive and negative high voltage circuits isolated from the vehicle chassis. This parameter displays the status of the Hybrid/EV battery pack isolation diagnostic test. This test may run at accessory wake up or immediately following key-off. The status will clear whenever DTCs are cleared.
	HV Not Enabled	Running/Complete	
Hybrid/EV Battery DC Charging Negative Contactor Command	—	Varies	This parameter displays the T24 Battery Charger – DC Commanded state of the contactor (relay) on (-) side of the DC battery charging system.
Hybrid/EV Battery DC Charging Positive Contactor Command	—	Varies	This parameter displays the T24 Battery Charger – DC Commanded state of the contactor (relay) on (+) side of the DC battery charging system.
Hybrid/EV Battery Pack Charging Limit	—	Varies	This parameter displays the maximum charge power limit in watts of the Hybrid/EV battery pack based on current conditions such as temperature and state of charge.
Hybrid/EV Battery Pack Charging Request	—	Varies	This parameter displays the request to charge the Hybrid/EV Battery pack.
Hybrid/EV Battery Pack Coolant Control Solenoid Valve Command	—	Varies	This parameter displays the commanded position for the solenoid valve that controls the coolant flow through the Hybrid/EV battery pack cooling system. This position determines the percentage of coolant allowed to flow through the refrigerant/coolant exchanger (chiller).
Hybrid/EV Battery Pack Coolant Control Solenoid Valve Feedback	—	Varies	This parameter displays the actual position for the solenoid valve that controls the coolant flow through the Hybrid/EV battery pack cooling system. This position determines the percentage of coolant allowed to flow through the refrigerant/coolant exchanger (chiller).
Hybrid/EV Battery Pack Coolant Control Solenoid Valve Learn Status	—	Complete	This parameter displays the status of the learn test for the solenoid valve that controls the coolant flow through the Hybrid/EV battery pack.
Hybrid/EV Battery Pack Coolant Control Valve Position	—	Varies	This parameter displays the percentage of coolant flow allowed to both flow through and bypass the refrigerant/coolant exchanger (chiller).
Hybrid/EV Battery Pack Coolant Level Switch	—	Varies	This parameter displays the voltage signal from the coolant level switch contained in the Hybrid/EV battery pack coolant surge tank.
Hybrid/EV Battery Pack Coolant Pump Command	—	Varies	This parameter displays the commanded percentage coolant flow for the Hybrid/EV battery pack coolant pump.

Hybrid Powertrain Control Module 2 Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Description
Hybrid/EV Battery Pack Coolant Pump Feedback	—	45–55%	This parameter displays the internal diagnostic status of the Hybrid/EV battery pack coolant pump. A duty cycle of 45 to 55% indicates no internal pump faults detected.
Hybrid/EV Battery Pack Coolant Pump Speed	—	Varies	This parameter displays the actual speed of the Hybrid/EV battery pack coolant pump motor shaft.
Hybrid/EV Battery Pack Coolant Temperature Sensor 1	—	Varies	Two sensors monitor the temperature of coolant circulating through the Hybrid/EV battery pack. This parameter displays Sensor 1 which monitors temperature of the coolant entering the battery pack.
Hybrid/EV Battery Pack Coolant Temperature Sensor 2	—	Varies	Two sensors monitor the temperature of coolant circulating through the Hybrid/EV battery pack. This parameter displays Sensor 2 which monitors temperature of the coolant exiting the battery pack.
Hybrid/EV Battery Pack Current	—	Varies	This parameter displays the amount of current in amps flowing in or out of the Hybrid/EV battery pack.
Hybrid/EV Battery Pack Heater Power Command	—	Varies	This parameter displays the electric power in percent commanded by the Hybrid Powertrain Control Module 2 to the Hybrid/EV battery pack coolant heater in order to warm the battery pack.
Hybrid/EV Battery Pack Heater Power Command	—	Varies	This parameter displays the electric power in kW commanded by the Hybrid Powertrain Control Module 2 to the Hybrid/EV battery pack coolant heater in order to warm the battery pack.
Hybrid/EV Battery Pack Heater Power Limited	—	No	This parameter displays if the electric power available to the Hybrid/EV battery pack coolant heater is at its limit.
Hybrid/EV Battery Pack Heater Power Request	—	Varies	This parameter displays the electric power in kW requested by the hybrid powertrain control module 2 to the Hybrid/EV battery pack coolant heater in order to warm the battery pack.
Hybrid/EV Battery Pack Isolation Test Status	—	Passed	Vehicles equipped with high voltage storage and propulsion capability are designed with both the positive and negative high voltage circuits isolated from the vehicle chassis. This parameter displays the results obtained when the Hybrid/EV battery pack last performed its internal isolation diagnostic test. This test may run at accessory wake up or immediately following key-off. The status will be cleared whenever DTCs are cleared.
Hybrid/EV Battery Pack Maximum Voltage	—	Varies	This parameter displays the total Hybrid/EV battery pack maximum voltage measured during the current ignition cycle.
Hybrid/EV Battery Pack Minimum State of Charge Limit	—	Varies	This parameter displays the minimum permissible Hybrid/EV battery pack state of charge in percent. The Hybrid/EV system will not discharge the battery pack below this limit.
Hybrid/EV Battery Pack Minimum Voltage	—	Varies	This parameter displays the total Hybrid/EV battery pack minimum voltage measured during the current ignition cycle.
Hybrid/EV Battery Pack Multifunction Contactor Command	—	Varies	This parameter displays the Hybrid Powertrain Control Module 2 Commanded state of the contactor (relay) that supplies (+) power to the precharge resistor, the battery heater and the Charging contactor within the Hybrid/EV Battery pack.

Hybrid Powertrain Control Module 2 Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Description
Hybrid/EV Battery Pack Negative Contactor Command	HV Enabled	Closed	This parameter displays the Hybrid Powertrain Control Module 2 Commanded state of the contactor (relay) on the (-) side of the Hybrid/EV Battery pack.
	HV Not Enabled	Open	
Hybrid/EV Battery Pack Positive Contactor Command	HV Enabled	Closed	This parameter displays the Hybrid Powertrain Control Module 2 Commanded state of the contactor (relay) on the (+) side of the Hybrid/EV Battery pack.
	HV Not Enabled	Open	
Hybrid/EV Battery Pack Precharge Transistor Command	HV Enable Initiated	Closed	This parameter displays the Hybrid Powertrain Control Module 2 Commanded state of the operation of the Hybrid/EV Battery pack precharge transistor. Precharge occurs in the milliseconds prior to closing the main (+) bus contactor. By routing the high voltage through a resistor, precharge prevents voltage spikes from occurring whenever high voltage is enabled.
	HV Fully Enabled or HV Not Enabled	Open	
Hybrid/EV Battery Pack Resistance	—	Varies	This parameter displays the Hybrid/EV battery pack resistance value in ohms.
Hybrid/EV Battery Pack State of Charge	—	Varies	This parameter displays the percentage available capacity remaining in a Hybrid/EV battery pack.
Hybrid/EV Battery Pack State of Charge Gauge	—	Varies	This parameter displays the percentage Hybrid/EV battery pack state of charge as indicated to the operator of the vehicle.
Hybrid/EV Battery Pack Voltage	—	Varies	This parameter displays the electrical potential of the Hybrid/EV battery pack as currently monitored.
Hybrid/EV Battery System Precharge Current Too High	—	No	Precharge occurs in the milliseconds prior to closing the main (+) bus contactor. By routing the high voltage through a resistor, precharge prevents voltage spikes from occurring whenever high voltage is enabled. This parameter displays if the contactors are commanded open because of excessive Precharge current.
Hybrid/EV Battery System Precharge Time Short	—	No	Precharge occurs in the milliseconds prior to closing the main (+) bus contactor. By routing high voltage through a resistor, precharge prevents voltage spikes from occurring whenever high voltage is enabled. The time required to precharge is based upon the system voltage and capacitance. This parameter displays if the contactors are commanded open because the time required to precharge was too fast.
Hybrid/EV Battery System Precharge Time Too Long	—	No	Precharge occurs in the milliseconds prior to closing the main (+) bus contactor. By routing the high voltage through a resistor, precharge prevents voltage spikes from occurring whenever high voltage is enabled. The time required to precharge is based upon the system voltage and capacitance. This parameter displays if the contactors are commanded open because the time required to precharge was too slow.
Hybrid/EV Battery Temperature Sensor with Maximum Value	—	Varies	The Hybrid/EV battery pack contains many individual battery cells or modules. This parameter displays the index-number of the battery module that is reporting the maximum temperature value.

Hybrid Powertrain Control Module 2 Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Description
Hybrid/EV Battery Temperature Sensor with Minimum Value	—	Varies	The Hybrid/EV battery pack contains many individual battery cells or modules. This parameter displays the index-number of the battery module that is reporting the minimum temperature value.
Hybrid/EV Battery Thermal Conditioning Request	—	Varies	This parameter displays the desired thermal support for the Hybrid/EV battery pack. Active Heating and Active Cooling states indicate that high voltage electrical energy is being expended to meet the desired thermal conditioning.
Hybrid/EV Battery Thermal Conditioning Status	—	Varies	This parameter displays the actual thermal support for the Hybrid/EV battery pack. Active Heating and Active Cooling states indicate that high voltage electrical energy is being expended to meet the desired thermal conditioning.
Hybrid/EV Battery Voltage Sensor with Maximum Value	—	Varies	The Hybrid/EV battery pack contains many individual battery cells or modules. This parameter displays the index-number of the battery module voltage sensor that is reporting the highest voltage.
Hybrid/EV Battery Voltage Sensor with Minimum Value	—	Varies	The Hybrid/EV battery pack contains many individual battery cells or modules. This parameter displays the index-number of the battery module voltage sensor that is reporting the lowest voltage.
Hybrid/EV Battery Voltage Sensors Average	—	Varies	The Hybrid/EV battery pack contains many individual hybrid battery cells or modules. This parameter displays the average voltage measured at all of the cells/modules.
Hybrid/EV Electronics Coolant Pump Command	—	Varies	This parameter displays the percent commanded coolant flow for the Hybrid/EV electronics coolant pump.
Hybrid/EV Electronics Coolant Pump Feedback	—	45–55%	This parameter displays the internal diagnostic status for the Hybrid/EV electronics coolant pump. A duty cycle of 45 to 55% indicates no internal pump faults detected.
Hybrid/EV Electronics Coolant Pump Speed	—	Varies	This parameter displays the actual speed of the Hybrid/EV electronics coolant pump motor shaft.
Hybrid/EV Electronics Coolant Temperature	—	Varies	This parameter displays the temperature of the coolant within the hybrid electronics cooling system.
Hybrid/EV Powertrain Control Module Request	—	No	This parameter displays if the hybrid/EV powertrain control module (1) is requesting the contactors to be open.
Hybrid/EV/EV Battery Capacity	—	Varies	This parameter displays the capacity of the hybrid/EV battery pack expressed in engineering data form.
Ignition 1 Signal	—	Varies	This parameter displays the voltage monitored at the control module terminal connected to the Ignition 1 circuit.
Isolation Test Resistance	—	Varies	Vehicles equipped with high voltage storage and propulsion capability are designed with both the positive and negative high voltage circuits isolated from the vehicle chassis. This parameter displays the amount of isolation observed when the Hybrid/EV battery pack last performed its isolation diagnostic test. This test may run at accessory wake up or immediately following key-off. The value will be set to zero whenever DTCs are cleared.

Hybrid Powertrain Control Module 2 Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Description
Maximum Hybrid/EV Battery Module Temperature	—	Varies	The Hybrid/EV battery pack contains many individual battery cells or modules. This parameter displays the temperature of the battery module reporting the highest temperature.
Maximum Hybrid/EV Battery Module Voltage	—	Varies	The Hybrid/EV battery pack contains many individual hybrid battery cells or modules. This parameter displays the maximum voltage measured at any of the cells/modules.
Minimum Hybrid/EV Battery Module Temperature	—	Varies	The Hybrid/EV battery pack contains many individual battery cells or modules. This parameter displays the temperature of the battery module reporting the lowest temperature.
Minimum Hybrid/EV Battery Module Voltage	—	Varies	The Hybrid/EV battery pack contains many individual hybrid battery cells or modules. This parameter displays the minimum voltage measured at any of the cells/modules.
Overtemperature	—	No	This parameter displays if the system is commanding contactors open to protect them from overheating. The contactors will overheat if cycled too many times within a short amount of time.
Passenger Compartment Heater Power Limited	—	No	This parameter displays if the electric power available to the passenger compartment heater power is at its limit.
Power Delivered to Electric A/C Compressor from Hybrid Battery Pack	—	Varies	This parameter displays the electric power in kW commanded by the hybrid powertrain control module 2 to the A/C compressor in order for it to provide Hybrid/EV battery pack and/or passenger compartment cooling.
Power Delivered to Electric Passenger Compartment Heater from Hybrid/EV Battery Pack	—	Varies	This parameter displays the electric power in kW commanded by the hybrid powertrain control module 2 to the passenger compartment heater in order for it to provide heat.
Power Requested by Electric A/C Compressor from Hybrid/EV Battery Pack	—	Varies	This parameter displays the electric power in kW estimated by hybrid powertrain control module 2 necessary to provide Hybrid/EV battery pack and/or passenger compartment cooling.
Power Requested by Electric Passenger Compartment Heater from Hybrid/EV Battery Pack	—	Varies	This parameter displays the electric power in kW estimated by hybrid powertrain control module 2 necessary to provide passenger compartment heating.
Power Mode	—	Run	This parameter displays the status of the ignition switch.
Proximity Detection Circuit	—	Varies	The proximity detection circuit detects the presence of the drive motor battery charge cord. This parameter displays the voltage monitored on the detection circuit.
Requested DC Charging Current	—	Varies	This parameter displays the amount of DC charge current requested by the hybrid powertrain control module 2 of the off-vehicle DC charge station.
Shutdown Mode	—	No	Shutdown Mode is the semi-operational state while a control module is turning off. Shutdown mode allows time for house-keeping tasks such as writing data to stored memory. This parameter displays if the module is in the process of shutting down.

Hybrid Powertrain Control Module 2 Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Description
Stuck Open	—	No	This parameter displays the contactors are commanded open because the module has detected one or more of the high voltage contactors will not close.
Warm-Ups Since DTC Cleared	—	Varies	This parameter displays the number of OBD defined warm-up cycles since the last time codes were cleared with a scan tool or, when applicable, with a 12V battery disconnect. A warm-up cycle occurs after the propulsion system has been active for 1000 consecutive seconds with run/crank ignition active.

Hybrid Powertrain Control Module 2 Scan Tool Output Controls

Output Control	Description
A/C Compressor Speed	This output control is used to vary the electric air conditioning compressor motor output speed.
Check High Voltage System Related DTCs	• The hybrid powertrain control module 2 monitors for high voltage safety conditions. If these conditions are present the module will set DTCs and prevent high voltage enabling. • This output control identifies if the related DTCs have passed.
Clear Secured High Voltage DTCs	• This output control is used to clear a latched high voltage (HV) lockout state. • The hybrid powertrain control modules 1 and 2 monitor for high voltage safety conditions such as airbag deploy events and certain HV system faults. • If these conditions are present either module may set a DTC and prevent HV enabling until after this Output Control is exercised. **Note:** Performing a scan tool DTC Clear may clear the diagnostic that set the HV lockout state, but will not reset the lockout. • Always refer to *Clear Secured High Voltage DTCs on page 9-539* procedure in Hybrid/ Energy Storage service information for the proper sequence of procedures required to reset a HV lockout state.
Cooling Fan Motor	This output control is used to vary the coolant radiator cooling fan motor between 10% and 90%.
DC Charge Port Lock	This output control is used to energize the M110 Charger Receptacle Lock Actuator which locks the charge cord to the vehicle.
Hybrid/EV Battery Contactors	This output control is used to energize the high voltage contactors for diagnostic purposes. Refer to the applicable high voltage contactor diagnostic trouble code for setup and usage instructions.
Hybrid/EV Battery Negative Contactor	This output control is used to energize the high voltage contactors for diagnostic purposes. Refer to the applicable high voltage contactor diagnostic trouble code for setup and usage instructions.
Hybrid/EV Battery Pack Active Cooling	This output control is used to enable Active Cooling of the Hybrid/EV Battery Pack. The electric A/C compressor will be turned ON and the coolant control valve will be set to the chiller position allowing the air conditioning refrigerant to cool the hybrid/EV battery coolant.
Hybrid/EV Battery Pack Coolant Control Solenoid Valve	This output control is used to energize the Q65 Hybrid/EV Battery Pack Coolant Control Valve. The valve has one fluid input port and three fluid output ports, identified as Radiator, Bypass, and Chiller. Bypass does not allow coolant to pass through either heat exchanger. The valve can be moved to several intermediate positions between Bypass and Chiller, for blended cooling of the hybrid/EV battery pack coolant for optimum efficiency.
Hybrid/EV Battery Pack Coolant Pump	This output control is used to vary the coolant pump speed between 20% and 90%.
Hybrid/EV Battery Pack Coolant Pump Bleed Procedure	This output control is used with the Drive Motor Battery Cooling System Draining and Filling procedure and the GE-47716 Van-N-Fill Coolant Refill Tool or its equivalent regional tool.
Hybrid/EV Battery Pack Heater Power	This output control is used to energize the Battery Pack Heater. The output control is limited to 10%. Refer to DTC P1EC6.

Hybrid Powertrain Control Module 2 Scan Tool Output Controls (cont'd)

Output Control	Description
Hybrid/EV Battery Pack Isolation Test	• Vehicles equipped with high voltage storage and propulsion capability are designed with both the positive and negative high voltage circuits isolated from the vehicle chassis. • This output control commands the hybrid powertrain control module 2 to measure the isolation of the hybrid/EV battery pack • The following control limits apply: – All high voltage contactors are open – The vehicle power mode is OFF Depress and hold the brake pedal while the vehicle power mode is OFF to wake up the modules prior to enabling this output control.
Hybrid/EV Battery Pack Precharge Transistor	This output control is used to energize the high voltage contactors for diagnostic purposes. Refer to the applicable high voltage contactor diagnostic trouble code for setup and usage instructions.
Hybrid/EV Battery Positive Contactor	This output control is used to energize the high voltage contactors for diagnostic purposes. Refer to the applicable high voltage contactor diagnostic trouble code for setup and usage instructions.
Hybrid/EV DC Charging Contactors	This output control is used to energize the high voltage DC charge contactors for diagnostic purposes. Refer to the applicable high voltage contactor diagnostic trouble code for setup and usage instructions.
Hybrid/EV Electronics Coolant Pump	This output control is used to vary the coolant pump speed between 20% and 90%.
Hybrid/EV Multifunction Contactor	This output control is used to energize the high voltage contactors for diagnostic purposes. Refer to the applicable high voltage contactor diagnostic trouble code for setup and usage instructions.

Inflatable Restraint Passenger Presence System Scan Tool Information

Passenger Presence Module Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Ignition ON		
Base Model Part Number	Varies, 8 Digit Number	The scan tool displays the part number of the PPS module which is stored in non volatile memory.
Battery Voltage	Volts	The scan tool will display battery voltage.
Calibration Part Number	Varies, 8 Digit Number	The scan tool displays the part number of the calibration file in the PPS module.
End Model Part Number	Varies, 8 Digit Number	The scan tool displays the part number of the PPS module in production.
Manufacturer's Traceability Number	Varies, 16 Digit Number	The scan tool displays the 16 digit traceability number in the PPS module.
Passenger Air Bag Enable/Disable Request by Passenger Presence Module	Disable	The scan tool displays the Passenger Air Bag Enable/ Disable Request by Passenger Presence Module.
Passenger Presence Module Primary Key	Hex Value	The scan tool indicates the primary key Hex value.
Passenger Presence System Reporting DTC(s)	Yes/No	The PPS module will report if there are DTCs set in the passenger presence module.
Passenger Seat Occupancy Status	Empty Seat	The scan tool displays Undefined, Empty Seat, Occupied, or Invalid. This is the state of the passenger seat if it is occupied or empty and monitored by the passenger presence system.
Power Mode	Off / Accessory / Run / Crank Request	The scan tool will display the power mode of the vehicle.
Primary Key Status	Valid/Invalid	The scan tool displays Valid if the primary key matches what is stored to memory in the PPS module.
Received Primary Key	Hex Value	The scan tool displays a Hex value indicating the PPS module received primary key data.

Passenger Presence Module Scan Tool Data Parameters (cont'd)

Parameter	Expected Value	Definition
Software Part Number	Varies, 8 Digit Number	The scan tool displays the software part number in the PPS module.

Inflatable Restraint Sensing and Diagnostic Module Scan Tool Information

Note: Some parameters and values in the table below may not apply to every vehicle.

Sensing and Diagnostic Module Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Ignition ON		
2nd Row Left Seat Belt Reminder Sensor Pad Enable Status	Disabled/Enabled	The scan tool displays if the left rear seat belt reminder sensor pad is enabled to the SDM.
2nd Row Left Seat Belt Reminder Sensor Pad Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the left rear seat belt reminder sensor pad has been learned by the SDM.
2nd Row Left Seat Belt Status	Buckled/Unbuckled	The scan tool displays Buckled or Unbuckled. This is the state of the left rear seat belt switch when the seat belt is buckled or unbuckled.
2nd Row Middle Seat Belt Reminder Sensor Pad Enable Status	Disabled/Enabled	The scan tool displays if the rear middle seat belt reminder sensor pad is enabled to the SDM.
2nd Row Middle Seat Belt Reminder Sensor Pad Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the rear middle seat belt reminder sensor pad has been learned by the SDM.
2nd Row Middle Seat Belt Status	Buckled/Unbuckled	The scan tool displays Buckled or Unbuckled. This is the state of the middle rear seat belt switch when the seat belt is buckled or unbuckled.
2nd Row Middle Seat Belt Reminder Sensor Pad Enable Status	Disabled/Enabled	The scan tool displays if the rear right seat belt reminder sensor pad is enabled to the SDM.
2nd Row Middle Seat Belt Reminder Sensor Pad Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the rear right seat belt reminder sensor pad has been learned by the SDM.
2nd Row Right Seat Belt Status	Buckled/Unbuckled	The scan tool displays Buckled or Unbuckled. This is the state of the right rear seat belt switch when the seat belt is buckled or unbuckled.
Air Bag Malfunction Indicator	On/Off/Flashes	The scan tool will display On or Flashes if there is a problem with the SIR system. Any problems within the SIR system will illuminate the air bag indicator. The indicator will either flash or stay on.
Base Model Part Number	Varies, 8 Digit Number	The scan tool displays the part number of the SDM which is stored in non volatile memory.
Calibration Part Number	Varies, 8 Digit Number	The scan tool displays the part number of the calibration file in the SDM.
Deployment Loop 1-18 Enable Status	Enabled/Disabled	The scan tool displays Enabled or Disabled. This is the status of the air bag or pretensioner.
Deployment Loop 1-18 Learn Status	Learned/Not Learned	The scan tool displays Learned or Not learned. Learned is displayed if the SDM has defined the number loop programmed from an air bag or pretensioner.
Deployment Loop 1-18 Resistance	1.44–4.25 Ohms	The scan tool displays the resistance of the learned loop of the air bag or pretensioner when connected to the SDM.
Deployment Loop 1-18 Type	Varies	The scan tool displays the name of the air bag or pretensioner associated with the loop type 1–18.
Driver Seat Belt Reminder Indicator	On/Off	The scan tool displays On if this indicator is on. If the indicator is on it means the seat belt has not been buckled.

Sensing and Diagnostic Module Scan Tool Data Parameters (cont'd)

Parameter	Expected Value	Definition
Driver Seat Belt Sensor Enable Status	Enabled/Disabled	The scan tool displays if the seat belt sensor in the seat belt buckle is enabled to the SDM.
Driver Seat Belt Sensor Learn Status	Learned/Not learned	The scan tool displays Learned or Not Learned. Learned is displayed if the driver seat belt sensor has been learned by the SDM.
Driver Seat Belt Status	Buckled/Unbuckled	The scan tool displays Buckled or Unbuckled. This is the state of the driver seat belt switch when the seat belt is buckled or unbuckled.
Driver Seat Position Sensor	Rearward/Forward	The scan tool will display if the driver seat is forward or rearward of the sensor set position.
Driver Seat Position Sensor Enable Status	Enabled/Disabled	The scan tool displays if the seat position sensor is enabled to the SDM.
Driver Seat Position Sensor Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the driver seat position sensor has been learned by the SDM.
End Model Part Number	Varies, 8 Digit Number	The scan tool displays the part number of the SDM in production.
Impact Sensor 1-8 Enable Status	Enabled/Disabled	The scan tool displays Enabled or Disabled This is the status of the impact sensor.
Impact Sensor 1-8 Learn Status	Learned/Not Learned	The scan tool displays Learned or Not learned. Learned is displayed if the SDM has learned and has assigned a number to that impact sensor.
Impact Sensor 1-8 Type	Equipped/Not Equipped	The scan tool displays the name of the impact sensor associated with the type 1–8.
Inflatable Restraint Sensing and Diagnostic Module Primary Key	Hex Value	The scan tool indicates the primary key Hex value.
Manufacturer's Traceability Number	Varies, 16 Digit Number	The scan tool displays the 16 digit traceability number in the SDM.
Module Setup	Incomplete/Complete	The scan tool indicates if the SDM is set up.
Passenger Air Bag Disabled Switch	On/Off	The scan tool displays Off when the customer manually turns the passenger airbag off with this switch.
Passenger Air Bag Off Indicator	On/Off	The scan tool displays Off when the passenger indicator is not illuminated. This indicator is off when the disable switch is in the off position or no one is sitting in the passenger seat.
Passenger Air Bag On Indicator	On/Off	The scan tool displays On when the passenger indicator is illuminated. This indicator is on when the disable switch is in the on position and someone is sitting in the passenger seat.
Passenger Air Bag Status	Enabled/Disabled	The scan tool displays if the passenger air bag is enabled to the SDM.
Passenger Air Bag Disable Indicator Enable Status	Enabled/Disabled	The scan tool displays if the passenger air bag disable indicator is enabled to the SDM.
Passenger Air Bag Disable Indicator Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the SDM has learned the status of the passenger air bag disable indicator.
Passenger Air Bag Disable Switch Enable Status	Enabled/Disabled	The scan tool displays if the passenger air bag disable switch is enabled to the SDM.
Passenger Air Bag Disable Switch Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the SDM has learned the status of the passenger air bag disable switch.
Passenger Air Bag Enable Indicator Enable Status	Enabled/Disabled	The scan tool displays if the passenger air bag enable indicator is enabled to the SDM.
Passenger Air Bag Enable Indicator Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the SDM has learned the status of the passenger air bag enable indicator.
Passenger Classification	00–07	The scan tool will display what type of individual is sitting in the passenger seat.

Sensing and Diagnostic Module Scan Tool Data Parameters (cont'd)

Parameter	Expected Value	Definition
Passenger Presence Detection System Enable Status	Enabled/Disabled	The scan tool displays if the passenger presence system is enabled to the SDM.
Passenger Presence Detection System Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the SDM has learned the passenger presence system.
Passenger Presence Detection System Reporting DTC(s)	Yes/No	The SDM will report if there are DTCs set in the passenger presence module.
Passenger Seat Belt Reminder Indicator	On/Off	The scan tool displays On if this indicator is on. If the indicator is on it means the seat belt has not been buckled.
Passenger Seat Belt Reminder Indicator Enable Status	Disabled/Enabled	The scan tool displays if the passenger seat belt reminder indicator is enabled to the SDM.
Passenger Seat Belt Reminder Indicator Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the passenger seat belt reminder indicator has been learned by the SDM.
Passenger Seat Belt Reminder Sensor Pad Enable Status	Disabled/Enabled	The scan tool displays if the passenger seat belt reminder sensor pad is enabled to the SDM.
Passenger Seat Belt Reminder Sensor Pad Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the passenger seat belt reminder sensor pad has been learned by the SDM.
Passenger Seat Belt Sensor Enable Status	Enabled/Disabled	The scan tool displays if the seat position sensor is enabled to the SDM.
Passenger Seat Belt Sensor Learn Status	Learned/Not learned	The scan tool displays Learned or Not Learned. Learned is displayed if the passenger seat belt sensor has been learned by the SDM.
Passenger Seat Belt Status	Buckled/Unbuckled	The scan tool displays Buckled or Unbuckled. This is the state of the passenger seat belt switch when the seat belt is buckled or unbuckled.
Passenger Seat Occupancy Status	Empty Seat/Occupied	The scan tool displays Occupied if someone is sitting in the passenger seat.
Passenger Seat Position Sensor	Rearward/Forward	The scan tool will display if the passenger seat is forward or rearward of the sensor set position.
Passenger Seat Position Sensor Enable Status	Disabled/Enabled	The scan tool displays if the passenger seat position sensor pad is enabled to the SDM.
Passenger Seat Position Sensor Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the passenger seat position sensor has been learned by the SDM.
Power Mode	Off/Accessory/Run/ Crank Request	The scan tool will display the power mode of the vehicle.
Primary Key Status	Valid/Invalid	The scan tool displays Valid if the primary key matches what is stored to memory in the SDM.
Primary Key Status Last Ignition Cycle	Invalid/Valid	The SDM checks to see if the primary key data received is valid.
Received Primary Key	Hex Value	The scan tool displays a Hex value indicating the SDM received primary key data.
Rollover Sensor Enable Status	Disabled/Enabled	The scan tool displays if the rollover sensor is enabled to the SDM.
Rollover Sensor Learn Status	Learn/Unlearn	The scan tool displays Learned or Not Learned. Learned is displayed if the rollover sensor has been learned by the SDM.
Security Code Accepted	Yes/No	The SDM either accepts the security code or it does not. The scan tool displays Yes if the security code has been accepted by the SDM.
Security Code Lockout	Yes/No	The scan tool displays Yes if the SDM has been locked out because of the security code not being accepted.
Security Code Lockout Active Timer	Random Value	The SDM uses a timer before the security code is locked in the SDM.
Security Code Programmed	Yes/No	The scan tool displays Yes if the SDM has been programmed with the security code.

Sensing and Diagnostic Module Scan Tool Data Parameters (cont'd)

Parameter	Expected Value	Definition
Security Code Programming Counter	Random Value	The SDM uses a counter for the value of the security code programming.
Security Code Reset Counter	Random Value	The SDM uses a counter to reset the value of the security code.
Software Part Number	Varies, 8 Digit Number	The scan tool displays the software part number in the SDM.
Vehicle Identification Number	Varies, 17 Digit Number	The VIN number of the vehicle programmed into the SDM.
VIN Programmed	Yes/No	The scan tool displays Yes if the VIN has been programmed into the SDM.
VIN Programming Counter	Random Value	The SDM uses this counter while programming the VIN.

Instrument Cluster Scan Tool Information

Instrument Cluster Scan Tool Data Parameters

Parameter	Expected Value	Description
Operating Conditions: Vehicle in Service Mode		
Ambient Air Temperature	15 °C	The scan tool displays outside temperature in °C.
Battery Voltage	12–14 V	The scan tool displays Volts. This is the current battery voltage signal.
Coolant Level Switch	Open	The scan tool displays either Open, Closed, or Not Available.
Driver Information Center Switch	Active/Inactive	The scan tool displays Active or Inactive. This is the state of the driver information center reset switch.
Driver Information Center Switch	Varies	The scan tool displays Volts. This is the current driver information center switch input voltage.
	Inactive	The scan tool displays either Inactive, Up, Down, or Menu. This is the state of the driver information center switch.
Engine Speed	Varies	The scan tool displays the engine RPM.
Odometer Lock Status	Active/Inactive	The scan tool displays Active or Inactive. Active means the odometer is locked.
Washer Fluid Level Switch	Open	The scan tool displays either Open, Closed, or Not Available.
Vehicle Speed	Varies	The scan tool displays the vehicle speed.

Instrument Cluster Scan Tool Output Controls

Output Control	Description
All Indicators	This function is used to command all the indicators ON or OFF.
CAN Bus Configuration Learn	This function is used to Reset the source ID for low speed CAN Bus communications.
Driver Information Center Dimming	This function is used to command the dimming of the driver information display to Increase or Decrease by 10%.
Driver Information Center Options	This function is used to command the driver information center buttons using the scan tool.
Driver Information Center Segments	This function is used to command the driver information center segments ON and OFF.
Instrument Cluster Gauge Sweep	Since there are no gauges, the instrument cluster will go through a screen test sequence instead of sweeping the gauges.

Keyless Entry Control Module Scan Tool Information

Keyless Entry Control Module Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Battery Voltage	V	This parameter indicates the battery voltage as measured at the module
Driver Door Ajar Switch	Active/Inactive	This parameter indicates that the driver door is ajar; it is open, but the safety latch is engaged.
Driver Door Open Switch	Active/Inactive	This parameter indicates that the driver door is more than just ajar, it is open.
Driver Door Unlock Switch	Active/Inactive	This parameter indicates if the driver door is locked or unlocked.
Exterior Driver Door Handle Switch	Active/Inactive	This switch begins the challenge and response to determine if the door should be unlocked. If the vehicle responds correctly to the challenge, the door will be unlocked or unlatched.
Exterior Driver Door Handle Proximity Sensor	Active, Inactive, Fault	This is a capacitive proximity sensor on the exterior of the driver door handle. It allows the user to lock the door by pressing a small rectangle on the outside of the door handle if a key is detected leaving the vehicle.
Passenger Door Open Switch	Active/Inactive	This parameter indicates that the passenger door is more than just ajar, it is open.
Passenger Door Ajar Switch	Active/Inactive	This parameter indicates that the passenger door is ajar; it is open, but the safety latch is engaged.
Exterior Passenger Door Handle Switch	Active/Inactive	This switch begins the challenge and response to determine if the door should be unlocked. If the vehicle responds correctly to the challenge, the door will be unlocked or unlatched.
Exterior Passenger Door Handle Proximity Sensor	Active, Inactive, Fault	This is a capacitive proximity sensor on the exterior of the driver door handle. It allows the user to lock the door by pressing a small rectangle on the outside of the door handle if a key is detected leaving the vehicle.
Left Rear Door Ajar Switch	Active/Inactive	This parameter indicates that the driver's side rear door is ajar; it is open, yet the safety latch is engaged.
Exterior Left Rear Door Handle Switch	Active/Inactive	This switch begins the challenge and response to determine if the door should be unlocked. If the vehicle responds correctly to the challenge, the door will be unlocked or unlatched.
Right Rear Door Ajar Switch	Active/Inactive	This parameter indicates that the passenger's side rear door is ajar; it is open, yet the safety latch is engaged.
Exterior Right Rear Door Handle Switch	Active/Inactive	This switch begins the challenge and response to determine if the door should be unlocked. If the vehicle responds correctly to the challenge, the door will be unlocked or unlatched.
Liftgate Ajar Switch	Active/Not Active	This switch indicates if the rear closure of the vehicle is ajar.
Liftgate Handle Switch	Active/Inactive	This switch begins the challenge and response to determine if the rear closure should be unlatched. If the vehicle responds correctly to the challenge, the rear liftgate will be unlatched.

Motor Control Module 1 Scan Tool Information

Motor control module 1 is a non-serviceable module within the power inverter module, often referred to as the drive motor generator power inverter module assembly. The Motor Control Module 1 Scan Tool Data Parameters list contains hybrid controls-related parameters. The list is arranged in alphabetical order.

Use the Motor Control Module 1 Scan Tool Data Parameters list only after the following is determined:

- The *Diagnostic System Check - Vehicle on page 6-91* is completed.
- No diagnostic trouble codes (DTCs)
- On-board diagnostics are functioning properly

The scan tool values from a properly running vehicle may be used for comparison with the vehicle you are diagnosing. The Motor Control Module 1 Scan Tool Data Parameters list represents values that would be seen on a normally running vehicle.

Note: A scan tool that displays faulty data should not be used. The scan tool concern should be reported to the manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.

Only the parameters listed below are referenced in this service manual for use in diagnosis. If all values are within the typical range described below, refer to *Symptoms - Hybrid Controls on page 9-167* for diagnosis.

Motor Control Module 1 Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Vehicle ON/Closed Throttle/Park or Neutral/Accessories OFF, unless otherwise noted			
Drive Motor 1 Current	—	Varies	This indicates the DC current consumed by hybrid electric motor 1.
Drive Motor 1 Inverter Status	—	Varies	This indicates the state of the Motor 1 Inverter.
Drive Motor 1 Inverter Supply Voltage Circuit	—	Varies	This indicates the voltage on the DC bus at the inverter for motor 1. This should be equal to the voltage measured at the inverter for motor 2.
Drive Motor 1 Inverter Temperature Sensor 1	—	Varies	Indicates the temperature of motor inverter temperature sensor 1.
Drive Motor 1 Inverter Temperature Sensor 2	—	Varies	Indicates the temperature of motor inverter temperature sensor 2.
Drive Motor 1 Inverter Temperature Sensor 3	—	Varies	Indicates the temperature of motor inverter temperature sensor 3.
Drive Motor 1 Negative Supply Isolation Voltage	—	Varies	This indicates the high voltage negative to chassis voltage as measured for motor 1.
Drive Motor 1 Phase U Current	—	Varies	This indicates the current flow to phase U of electric motor 1.
Drive Motor 1 Phase V Current	—	Varies	This indicates the current flow to phase V of electric motor 1.
Drive Motor 1 Phase W Current	—	Varies	This indicates the current flow to phase W of electric motor 1.
Drive Motor 1 Position Sensor Offset Learn Status	—	Varies	This indicates the status of the resolver offset learn for electric motor 1. This will update based on any resolver learn, whether performed automatically as part of normal vehicle operation or as the result of a device control.
Drive Motor 1 Positive Supply Isolation Voltage	—	Varies	This indicates the high voltage positive to chassis voltage as measured for motor 1.
Drive Motor 1 Speed	—	Varies	This indicates the speed, in revolutions per minute, of hybrid electric motor 1 as determined from the resolver.
Drive Motor 1 Temperature	—	Varies	This indicates the temperature for motor 1.
Drive Motor 1 Torque	—	Varies	This indicates the torque value for motor 1.
Hybrid Powertrain Control Module High Voltage Circuit	—	Varies	This displays the high voltage circuit voltage as detected by the hybrid powertrain control module which detects voltage in a range from 0–655.35 V.
Ignition 1 Signal	—	Varies	This parameter displays the voltage of the ignition feed circuit of the hybrid powertrain control module.

Object Alarm Module Scan Tool Information

Scan Tool data is not available. The K41R Rear Parking Assist Control Module is not on the serial data bus.

Power Steering Control Module Scan Tool Information

The power steering control module scan tool data parameters list contains all power steering related parameters that are available on the scan tool. The list is arranged in alphabetical order. A given parameter may appear in any one of the data lists.

Power Steering Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON			
Battery Voltage	—	Varies	This displays battery voltage.
Calculated System Temperature	—	Varies	This is the calculated temperature of the power steering system.
Steering Input Torque	—	Varies	This displays N•m This is the calculated force of the steering shaft, as monitored by the power steering control module.
Steering Wheel Angle	—	Varies	This displays the steering wheel angle in degrees.
Vehicle Speed	—	Varies	The scan tool displays the vehicle speed value.

Radio Scan Tool Information

Radio Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Ignition ON		
Antenna Module	Enabled	The scan tool displays Enabled or Disabled. This indicates if the system uses an antenna module and the output status between the radio and the antenna module.
Auxiliary Audio Input	Not Present	The scan tool displays Present or Not Present. This parameter displays present when an auxiliary input is connected.
Battery Voltage	Varies	The scan tool displays volts. This is the voltage at the input to the radio.
Digital Radio Receiver	Present	The scan tool displays Present or Not Present. This is the state of the Digital Audio Broadcast.
Power Mode	Run	The scan tool displays Off, Accessory, Run or Crank Request. This is the current power mode of the radio.
Radio Signal Strength	Varies	This displays the signal strength in dB. This is the signal strength of the currently tuned radio station.
Theft Lock Armed	Learned VIN	The scan tool displays Learned VIN or No VIN. This is the state of the VIN programming in the radio.
Radio Theft Lock Status	Inactive	The scan tool displays Active or Inactive. This is the state of the theft lock system. Active indicates the radio is locked. Inactive indicates the theft lock system is armed and the radio is unlocked.
Test Bench Mode	Inactive	The scan tool displays Active or Inactive. This parameter indicates if the radio is in bench or user mode.
End Model Part Number	Varies	End Model Part Number is the part number for the hardware of the control module with software and calibrations.
Base Model Part Number	Varies	Base Model Part Number is the part number for the hardware without software and calibrations.
Boot Software Part Number	Varies	The scan tool displays the boot software ID number.
Calibration Part Number 1	Varies	The scan tool displays the software module ID 1.
Calibration Part Number 2	Varies	The scan tool displays the software module ID 2.
Calibration Part Number 3	Varies	The scan tool displays the software module ID 3.
Calibration Part Number 4	Varies	The scan tool displays the software module ID 4.
Calibration Part Number 5	Varies	The scan tool displays the software module ID 5.
Calibration Part Number 6	Varies	The scan tool displays the software module ID 6.
Calibration Part Number 7	Varies	The scan tool displays the software module ID 7.
Calibration Part Number 8	Varies	The scan tool displays the software module ID 8.
Calibration Part Number 9	Varies	The scan tool displays the software module ID 9.
Calibration Part Number 10	Varies	The scan tool displays the software module ID 10.
Digital Radio Receiver ID	Varies	The scan tool displays the Digital Audio Broadcast receiver ID.

Radio Scan Tool Data Parameters (cont'd)

Parameter	Expected Value	Definition
Vin Digits 2-17	Varies	The scan tool displays the learned VIN digits 2-17.
Subscriber ID	Varies	Identifies the alphanumeric dealer code or the tester's (Tech2, MDI etc.) serial number. This string is programmed into the ECU memory during the last programming event.
Module Diagnostic Address	80	Displays the 2 digit diagnostic address of the control module.
Date Programmed	Varies	Displays the date when the ECU was last programmed.

Radio Scan Tool Output Controls

Scan Tool Output Control	Description
Left Front Speaker	This output control is used to command the speaker ON and OFF. Commanding the speaker ON will generate a test tone to be generated through the selected loudspeaker.
Left Rear Speaker	This output control is used to command the speaker ON and OFF. Commanding the speaker ON will generate a test tone to be generated through the selected loudspeaker.
Right Front Speaker	This output control is used to command the speaker ON and OFF. Commanding the speaker ON will generate a test tone to be generated through the selected loudspeaker.
Right Rear Speaker	This output control is used to command the speaker ON and OFF. Commanding the speaker ON will generate a test tone to be generated through the selected loudspeaker.
Eject	This output is a command to eject the disc.

Telematics Communication Interface Control Module Scan Tool Information

Telematics Communication Interface Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON			
GPS Data			
Dead Reckoning Calibration Status	—	Calibrated or Not Calibrated	Indicates the dead reckoning calibration status.
Position Calibration Method	—	Varies	Indicates the method used to determine current location. (0) GPS, (1) Wheel Speed Dead Reckoning only, (2) Combined Wheel Speed and GPS, (3) Gyro only, (4) Combined Gyro and GPS, (5) No Fix
Month	—	MM	This displays the current month.
Day	—	DD	This displays the current day of the month.
Year	—	YY	This displays the current year.
Hour	—	HH	This displays the GPS current hour (24 hour format – GMT).
Minute	—	MM	This displays the GPS current minute.
Second	—	SS	This displays the GPS current second.
Number of Satellites Tracked	—	Varies	The scan tool displays the number of satellites being tracked by the telematics communication interface control module.
Signal Strength Data			
GSM Signal Strength	—	Varies	The scan tool displays 0–127. This is the telematics communication interface control module signal strength.
Current Public Land Mobile Network	—	Varies	Identifies the cellular communications network currently in use by the telematics communication interface control module. Each network has a unique decimal number assigned to it for identification.

Telematics Communication Interface Control Module Scan Tool Data Parameters (cont'd)

Parameter	System State	Expected Value	Description
Bluetooth Data			
Bluetooth	—	Enabled	Indicates if the Bluetooth system is enabled or disabled.
Bluetooth Link Status	—	Varies	Indicates the current link status. (0) Unconnected, (1) Connected / Idle, (2) Call active, (3) 3-way calling active
Bluetooth Link Quality	—	Varies	The scan tool displays a decimal value between 0 and 255.
Bluetooth Phone to Telematics Communication Interface Control Module Authentication Status	—	Active or Inactive	Displays the bluetooth phone to telematics communication interface control module authentication status.
Bluetooth Phone to Telematics Communication Interface Control Module Communication Status	—	Active or Inactive	Displays the bluetooth phone to telematics communication interface control module status.
Bluetooth Phone Voice Recognition Status	—	Active or Inactive	Displays the bluetooth phone to voice recognition status.
WLAN Device Data			
Off-Board Navigation	—	Enabled or Disabled	Indicates if Off-Board Navigation is enabled or disabled
Wireless LAN	—	Enabled or Disabled	Indicates the capability of the wireless communication of the Telematics Communication Interface Control Module
Number of WLAN Devices	—	Varies	Indicates the number of Wireless devices present
Active WLAN 2.4GHz Chennel	—	Varies	Indicates the active Wireless channel being used on the 2.4 GHz frequency
WLAN Link Status	—	Radio System – Never, Remembered but Not Associated or Associated	Indicates the link status of the Telematics Communication Interface Control Module and Infotainment system
GSM Signal Strength	—	Varies	State for Received Signal Strength Indicator
Mobile Communication Standard	—	2G, 3G, 4G or 4G LTE	State for Cellular Data Connection. Indicates the currently used data rate speed
WLAN Password	—	Varies	Indicates the Telematics Communication Interface Control Module Wireless Password
WLAN SSID (Service Set Identifier)	—	Varies	Indicates the Telematics Communication Interface Control Module Wireless Service Name
WLAN Encryption – WPA (Wi–Fi Protected Access)	—	Active or Inactive	Indicates if the WLAN Encryption – WPA (Wi–Fi Protected Access) is Active or Inactive
WLAN Encryption – WPA2 (Wi–Fi Protected Access II)	—	Active or Inactive	Indicates if the WLAN Encryption – WPA2 (Wi–Fi Protected Access II) is Active or Inactive
WLAN Encryption – AES (Advanced Encryption Standard)	—	Active or Inactive	Indicates if the WLAN Encryption – AES (Advanced Encryption Standard) is Active or Inactive
WLAN Encryption – TKIP (Temporal Key Intergrity Protocol)	—	Active or Inactive	Indicates if the WLAN Encryption – TKIP (Temporal Key Integrity Protocol) is Active or Inactive

Telematics Communication Interface Control Module Scan Tool Output Controls

Output Control	Description
B1000 Information	This shows the data recorded when DTC B1000 was set in the telematics communication interface control module.
Green Indicator	The telematics communication interface control module illuminates the green LED when ON is selected.

Telematics Communication Interface Control Module Scan Tool Output Controls (cont'd)

Output Control	Description
Phone Call Test	When ON is selected, telematics communication interface control module commands OnStar to connect to the OnStar Center.
Red Indicator	The telematics communication interface control module illuminates the red LED when ON is selected.
Preferred Roaming List Update	The telematics communication interface control module performs a preferred roaming list (PRL) update when this is selected.
Remote Vehicle Speed Limiting Reset	This function resets the speed limiting feature.

Diagnostic Information and Procedures

Strategy Based Diagnosis

The goal of Strategy Based Diagnosis is to provide guidance when you create a plan of action for each specific diagnostic situation. Following a similar plan for each diagnostic situation, you will achieve maximum efficiency when you diagnose and repair vehicles. Although each of the Strategy Based Diagnosis steps are numbered, you are not required to complete every step in order to successfully diagnose a customer concern. The first step of your diagnostic process should always be Understand and Verify the Customer's Concern. The final step of your diagnostic process should be to Repair and verify the Fix. Refer to the steps listed below for the correct Strategy Based Diagnosis.

Note : For additional information on the following steps refer to the corresponding numbered paragraphs listed below.

1. Understand and verify the customers concern.
2. Verify the vehicle is not operating as designed:

⇒ **If the vehicle is operating as designed review the suggestions listed below:**

- Check Identical Vehicle
- Customer Misunderstanding of System – Explain operation to customer or refer to owners or service manual
- Customer dissatisfaction – Submit a Field Product Report

⇓ **If the vehicle is not operating as designed**

3. Perform preliminary checks – Visual inspections and operational

⇒ **If the customers concern is found, refer to step 7**

⇓ **If the customers concern is not found**

4. Perform the Diagnostic System Check – Vehicle, determine the diagnostic service category to perform.

⇒ **If the customers concern is found, refer to step 7**

⇓ **If the customers concern is not found**

5. Check for related Bulletins, Recalls and Preliminary Information.

⇒ **If the customers concern is found, refer to step 7**

⇓ **If the customers concern is not found**

6. Follow the diagnostic path listed below:
   - 6.1. Current DTC – Follow DTC Diagnostics
   - 6.2. Symptom no DTC – Follow Symptom Diagnostics
   - 6.3. No published diagnostic – Analyze and develop diagnostics or call Technical Assistance
   - 6.4. Intermittent/History DTC – See diagnostic detail below
7. Isolate the root cause then repair and verify the fix.
8. Re-examine the concern.

⇒ **If the vehicle is not repaired, refer to step 1**

⇓ **If the vehicle is repaired**

9. All OK.

Additional Information

1. Understand and Verify the Customer's Concern: The first part of this step is to obtain as much information as possible from the customer. Are there aftermarket accessories on the vehicle? When does the condition occur? Where does the condition occur? How long does the condition last? How often does the condition occur? In order to verify the concern, the technician should be familiar with the normal operation of the system and refer to the owner or service manual for any information needed.
2. Vehicle Operating as Designed: This condition exists when the vehicle is found to operate normally. The condition described by the customer may be normal. Compare with another like vehicle that is operating normally under the same conditions described by the customer. Explain your findings and the operation of the system to the customer. If the customer is dissatisfied submit a Field Product Report.
3. Preliminary Checks: Conduct a thorough visual inspection. Review the service history. Detect unusual sounds or odors. Gather diagnostic trouble code (DTC) information in order to achieve an effective repair.

4. Perform Published Diagnostic System Check-Vehicle: The *Diagnostic System Check - Vehicle on page 6-91* verifies the proper operation of the system. This will lead the technician in an organized approach to diagnostics and identify what category of diagnostic to perform.
5. Check for related Bulletins, Recalls and Preliminary Information (PI).
6. Diagnostic categories:
   - 6.1. Current DTC: Follow the designated DTC diagnostic in order to make an effective repair. Refer to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92*.
   - 6.2. Symptom - No DTC: Select the appropriate symptom diagnostic. Follow the diagnostic steps or suggestions in order to complete the repair. Refer to *Symptoms - Vehicle on page 6-122*.
   - 6.3. No Published Diagnostics: Analyze the Concern. Develop a plan for the diagnostics. The service manual schematics will help you to see system power, ground, input, and output circuits. You can also identify splices and other areas where multiple circuits are tied together. Look at component locations to see if components, connectors or harnesses may be exposed to extreme temperature, moisture, or corrosives (road salt, battery acid, oil or other fluids). Utilize the wiring diagrams, system description and operation, and system circuit description.
   - 6.4. Intermittent/History DTC: An intermittent condition is one that does not occur continuously, may be difficult to duplicate, and will only occur when certain conditions are met. Generally, an intermittent is caused by faulty electrical connections and wiring, malfunctioning components, electromagnetic/ radio frequency interference, driving conditions, or aftermarket equipment. The following approaches/tools may prove to be beneficial in locating and repairing an intermittent condition or history DTC.
     - Combining technicians knowledge with the available service information.
     - Evaluate the symptoms and conditions described by the customer on the *Customer Concern Verification Sheets on page 1-10*.
     - Follow the suggestions on *Testing for Intermittent Conditions and Poor Connections on page 11-877*.
     - Use the available scan tool, digital multi-meter, or *J-42598-B* vehicle data recorder with data capturing capabilities.
7. Isolate the Root Cause then Repair and Verify Fix: After isolating the root cause, make the repairs and validate for the correct operation by performing the *Diagnostic Repair Verification on page 6-123*. Verifying that the DTC or symptom has been corrected may involve road testing the vehicle.
8. Re-examine the Concern: If a technician cannot successfully find or isolate the concern, a re-evaluation is necessary. Re-verify the concern. The concern could be an intermittent or normal condition.

Diagnostic Procedure Instructions

The following is an overview of instructions for all 16 categories which may be included in a diagnostic procedure.

Diagnostic Instructions

A link to the *Diagnostic System Check - Vehicle on page 6-91* is provided here. This procedure should be performed prior to performing other diagnostic procedures, as this prevents misdiagnosis where there are integrated system dependencies.

A link to the *Strategy Based Diagnosis on page 6-83* is provided here. This provides an overview on how a technician should diagnose a vehicle.

A link to the *Diagnostic Procedure Instructions on page 6-84* is provided here. This information is an overview of instructions for all 16 categories which may be included in a diagnostic procedure.

DTC Descriptor

Describes what DTCs are diagnosed in this procedure. The DTC number, with Symptom Description when applicable, and descriptor are written out.

Diagnostic Fault Information

The diagnostic Fault Information table identifies each circuit that makes up an electrical subsystem and the associated circuit faults. DTCs and symptoms are listed in the table for all circuit fault modes. This information can be used to diagnose an electrical fault, or as a quick visual aid showing how the different symptoms and DTCs apply for the subsystem being diagnosed.

Even though all the DTCs and symptoms are shown in this table it does not mean they will all be diagnosed in the same procedure.

An example table from an engine coolant temperature (ECT) procedure:

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
ECT Sensor Signal	P0117	P0118	P0118	P0125, P0128
ECT Low Reference	—	P0118	P0118	P0125, P0128

Typical Scan Tool Data

The Typical Scan Tool Data table identifies a scan tool data parameter and its value in reference to potential circuit faults.

An example table from an ECT procedure:

ECT Sensor Temperature – PCM

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running **Parameter Normal Range:** −32 to +130°C (−26 to +275°F)			
ECT Signal	140°C (284°F)	−40°C (−40°F)	−40°C (−40°F)
Low Reference	—	−40°C (−40°F)	−40°C (−40°F)*
* Internal ECM damage may occur if shorted to B+			

Circuit/System Description

Circuit/System Description identifies how a circuit/system normally functions.

Conditions for Running the DTC

Conditions for Running the DTC, identifies what conditions must be present to allow the diagnostic to run.

Conditions for Setting the DTC

Conditions for Setting the DTC, identifies the condition(s) that must be present in order to fail the diagnostic and when to set the DTC.

Action Taken When the DTC Sets

Actions Taken When the DTC sets, identifies the default actions taken when a control module sets a DTC.

Conditions for Clearing the DTC

Conditions for Clearing the DTC, identifies the conditions that must be met in order to clear the DTC.

Diagnostic Aids

Diagnostic Aids are suggestions which explain other methods to diagnose the condition. It also provides unique information about the system used to assist the technician in finding and repairing a vehicle condition.

Reference Information

Reference Information includes links providing additional information for the diagnostic procedure.

For example:

- Schematic Reference
- Connector End View Reference
- Description and Operation
- Electrical Information Reference
- DTC Type Reference

- Scan Tool Reference
- Special Tools Required

Circuit/System Verification

The diagnostic format does not force a technician to any of the 3 diagnostic categories (Circuit/System Verification, Circuit/System Testing and Component Testing). However, performing the Circuit/System Verification category first, aids in determining if a vehicle condition is current. Some diagnostic categories may state that another category must be performed first when there are testing dependencies.

This category also serves to route the technician to other diagnostic procedures which should be performed first; for example, a DTC with a higher priority.

Note: Any diagnostic step that asks if a DTC is set is referring to a Set, Current, Present, Active DTC status. This does not include any other DTC status. For example History, Not Run, Passed and Failed.

Circuit/System Verification is a non-intrusive procedure outlining how to verify that a system or a portion of a system is functioning correctly. During the verification process, the vehicle is kept intact and tested as a complete system. This verification is used to assist the technician in determining whether a condition is current or intermittent. When a condition is determined to be intermittent, a technician can use the link in Electrical Information Reference: *Testing for Intermittent Conditions and Poor Connections on page 11-877* for additional testing information.

The technician should be able to identify if the fault is occurring on the input circuit - signal or on the output circuit - control when applicable. The technician will need to decide from the verification results if the system is working correctly or if further diagnosis needs to be performed in either Circuit/System Testing and/or Component Testing.

To assist the technician in identifying a common part a component code is used. These codes are not translated so they will always be the same even though the part name may have slight variance. The component codes will always be the same once assigned to a unique part name and will be found on the schematics and in the diagnostic procedure categories Circuit/System Verification, Circuit/System Testing, and Component Testing categories.

Component Codes

The component codes used on the schematics will have the base code with an extension to identify location or quantity. For example the ABS wheel speed sensors are identified on the schematic with a base code (B5) and a location extension (LF, RF, LR, and RR) as seen below:

- B5LF Wheel Speed Sensor (WSS)-Left Front
- B5RF Wheel Speed Sensor (WSS)-Right Front
- B5LR Wheel Speed Sensor (WSS)-Left Rear
- B5RR Wheel Speed Sensor (WSS)-Right Rear

B5 is the base code for the wheel speed sensor and the LF, RF, LR, and RR indicate the on vehicle location.

The diagnostic procedures will use the base code (B5) for a wheel speed sensor but may or may not use the extension identifying location (LF, RF, LR, and RR).

Example: Vehicle OFF, disconnect the harness connector at the appropriate B5 wheel speed sensor. This is done so the diagnostic procedure can be common for all four wheel speed sensors and not have to take into account part location or quantity.

Where the diagnostic states "the appropriate" it is up to the technician to identify which component is being diagnosed by the symptom stated on the RO (drivers door lock is inoperative) or by the DTC descriptor (DTC C0585 04: Left Rear Actuator Circuit Open).

Circuit/System Testing

The diagnostic format does not force a technician to any of the 3 diagnostic categories (Circuit/System Verification, Circuit/System Testing and Component Testing). However, beginning with the Circuit/System Verification category aids in determining if a vehicle condition is current. Some diagnostic categories may state that another category must be performed first when there are testing dependencies.

Circuit/System Testing is a step by step, positive-flow, testing sequence which allows the technician to perform each test step, in sequence, until a fault is detected. If the result of a numbered test step is achieved, the normal flow is to proceed to the next numbered test step (indicated by the down pass arrow). If the result of a numbered test step is NOT achieved, the right repair arrow bullet ⇒ below the failed test will identify what actions need to take place.

Intrusive diagnostics are performed to locate the system fault. System harness connections are disconnected from the module or component to test individual circuit functions. The module or component will be used to assist in verifying the circuit function. When a test does not pass, the repair steps (⇒) will indicate what circuit faults to test for example, short to voltage, short to ground or open/high resistance.

When testing for individual circuit faults, the technician is expected to include terminal inspections such as connection surfaces and terminal tension at both the harness and component/module. Additionally, a technician can use the links in Electrical Information Reference: *Testing for Intermittent Conditions and Poor Connections on page 11-877* or *Circuit Testing on page 11-871* for additional information.

The control modules and components will also be diagnosed during these test steps. A retest of a control module or component should always be performed before replacement. For example, re-connect all components and modules and retest the system to verify the condition still exists before replacing modules or components.

Component Testing

The diagnostic format does not force a technician to any of the 3 diagnostic categories (Circuit/System Verification, Circuit/System Testing and Component Testing). However, beginning with the Circuit/System Verification category aids in determining if a vehicle condition is current. Some diagnostic categories may state that another category must be performed first when there are testing dependencies.

Component Testing can offer static and/or dynamic component tests. These tests can be used to verify if a component is operating correctly to avoid unnecessary replacement.

Testing modules in this category will not be offered. In most cases, the module is used to verify the harness circuits in the Circuit/System Testing category and a retest of the module should always be performed before replacement.

Repair Instructions

Repair Instructions provides a link to *Diagnostic Repair Verification on page 6-123*. This link describes how to verify the vehicle is repaired.

All links to Repair or Replacement procedures are located here.

Repair Verification

Repair Verification describes how to verify the vehicle is repaired when additional instructions are needed beyond what is in Diagnostic Repair Verification.

Diagnostic System Check Instructions

The following is an overview of instructions for the general information and 14 step System Verification included in the Diagnostic System Check - Vehicle procedure.

Diagnostic Instructions

A link to *Strategy Based Diagnosis on page 6-83* is provided as an overview on how a technician should diagnose a vehicle.

A link to the Diagnostic System Check Instructions is provided. This provides an overview of instructions and examples for the general information and 14 step System Verification included in the Diagnostic System Check - Vehicle procedure. The examples in this document are intended to give the technician a general idea of what the test step is referring to. They are not intended to list every possible condition or situation.

Diagnostic Systems Check steps are listed by priority to guide the technician to the appropriate diagnostic procedure to correct the customer concern. There are many ways to determine the priority of diagnosing a vehicle concern. Some faults can cause customer perceived symptoms in areas unrelated to the fault. Using an example from the System Check, after reading DTCs, the technician is asked to verify there are no Electronic Control Unit Internal Performance Faults present. It is important that any internal performance issues are addressed prior to continuing through the System Check. There is no benefit addressing other DTCs that could be set due to an internal fault to a control module. If the fault is present, performing the diagnostic procedure for that fault will likely correct the customer perceived concern and possibly eliminate other DTCs that may be set.

Not all steps of the Diagnostic System Check have to be performed. The Diagnostic System Check tries to prioritize the test steps with the highest priority faults first. The technician is then lead to another document to do the actual diagnosis or repair. The strategy is to repair higher level faults that may be the cause of other system or component level symptoms. Additionally, the Diagnostic System Check can only be used for a single fault at a time. If additional faults are present, the technician must perform the diagnostic system check for each concern until all customer concerns are corrected.

Once a repair has been completed, General Motors diagnostic strategy is to always have the technician verify that the customer concern has been corrected. This is to prevent comebacks and to ensure customer satisfaction with their dealership experience. Therefore a link has been provided to *Diagnostic Repair Verification on page 6-123* procedure for the technician to verify the customer concern has been corrected.

There are some assumptions made when General Motors prepares service information. They include the following areas which are presumed to function as designed:

- The 12 V battery is fully charged. General Motors assumes the majority of vehicles brought in for repair will be able to start and be driven into the service stall. If the vehicle has a dead battery, it is slow cranking or for any other reason the technician feels the customer concern may be battery related, a link is provided to *Battery Inspection/Test on page 9-15*. This procedure will guide the technician through inspecting and verifying the battery functions properly.
- Fuses should not be open. General Motors does not call out in diagnostic procedures to verify a fuse. The technician is expected to find an open fuse when the diagnostic test step states to check for an open circuit condition. Therefore a link has been provided to *Power Distribution Schematics on page 11-314* and *Electrical Center Identification Views on page 11-430* for technicians to reference power sources and fuse locations if they feel there may be loss of power due to an open fuse condition.
- Ground circuits are clean, tight, and in the correct location. General Motors assumes that the original ground circuits have not been compromised. The technician is expected to find a poor ground connection when the diagnostic test step states to test the ground circuit for an open/high resistance. Therefore a link has been provided to *Ground Distribution Schematics on page 11-333* and *Harness Routing Views on page 11-252* for technicians to reference ground locations and which ground circuits may be related to the customer concern.
- All connections/connectors are fully seated. General Motors assumes that all connections are properly installed. The technician is expected to find an open or poor connection when the diagnostic test step asks to test the circuit for an open/high resistance. Therefore a link has been provided to *Component Connector End Views on page 11-455* for technicians to reference which connections may be related to the customer concern.
- There are no aftermarket devices that affect the operation of the system. General Motors can only author diagnostic and repair information for vehicle systems and components that are original

equipment or genuine GM Accessories. Aftermarket equipment can negatively affect original equipment operation and lead a technician's diagnosis of a concern in the wrong direction. Therefore a link has been provided to *Checking Aftermarket Accessories on page 11-871* that guides a technician through the possible causes of vehicle problems related to aftermarket accessories.

- The scan tool powers up. General Motors assumes that power is available at the Data Link Connector and the scan tool will power on. Therefore a link has been provided to *Scan Tool Does Not Power Up on page 11-218* if the technician finds that the scan tool does not power on.

Diagnostic System Check

1. VERIFY CUSTOMER CONCERN—This step is to obtain as much information as possible from the customer. Are there aftermarket accessories on the vehicle? When does the condition occur? Where does the condition occur? How long does the condition last? How often does the condition occur? Review the service history of the vehicle for previous repairs that could help diagnose the current concern.

   Now that the technician understands the customer concern, they should validate the concern on the vehicle. In order to verify the concern, the technician should be familiar with the normal operation of the system and refer to the owner or service manual for any information needed. Inspect the visible system components for obvious damage or conditions that could cause the concern. Conduct a thorough visual inspection. Detect unusual sounds or odors.

   The condition described by the customer may be normal. If the technician finds the vehicle to operate normally, compare with another like vehicle that is operating normally, under the same conditions described by the customer. If this is the case, explain your findings and the operation of the system to the customer. If the customer is dissatisfied, submit a Field Product Report.
2. BULLETIN SEARCH—By searching for related bulletins, recall/field actions and preliminary information documents, a procedure for a known field issue may resolve the customer concern with little or no diagnosis necessary saving the technician diagnostic time.
3. MECHANICAL CONCERNS—This step is designed to take the technician directly to a list of symptom diagnostic procedures. The technician is asked to verify the symptoms exhibited by the system are mechanical in nature and not related to an electrical system, see some examples below. If the technician feels the concern could be related to an electrical system, they should continue through the Diagnostic System Check to verify the electrical functionality of vehicle. If the technician feels the concern is exclusively related to a mechanical system, a link to *Symptoms - Vehicle on page 6-122* is provided to select the appropriate symptom diagnostic procedure for the customer concern.

   Examples:
   - Brake noise or diagnosing irregular pad wear
   - Water leak diagnosis
   - Engine or transmission fluid leak diagnosis
   - Manual window or door lock diagnosis
   - Vehicle vibration diagnosis
   - Exhaust noise or leak diagnosis
4. VEHICLE POWER UP VERIFICATION—The technician is asked in this step to turn the ignition key ON and verify that the vehicle powers up. The technician should look for clues that multiple vehicle systems are receiving vehicle powermode messages, such as the cluster waking up, the radio powers on, the HVAC blower is operational, windshield wipers turn on, etc, with the key ON. This would be a rare condition as both the powermode master and back-up powermode master would have to be inoperable, however, if the vehicle does not power up, a link to *Power Mode Mismatch on page 11-857* is provided.
5. CONTROL MODULE COMMUNICATION and DTC CHECK—The technician is asked in this step to record the following three pieces of data on the Repair Order; any control module that the scan tool determined is not communicating, any DTC and symptom byte set current or history, and the control module that has set the DTC.

   This is considered a setup step for the rest of the Diagnostic System Check. The technician is not expected to do anything other than record the three pieces of data provided by the scan tool on the Repair Order. This provides the information needed to complete the rest of the diagnostic system check.

   To complete this step, the technician is asked to utilize the scan tool function called Vehicle DTC Information located in Vehicle Control Systems. This function will query every possible control module on the vehicle requesting all DTCs. During the DTC query, the scan tool will try to establish communication with each control module. If the scan tool can communicate with the control module during the DTC request, it will display PRESENT and provide the number of DTCs set in the control module. If the scan tool cannot communicate with a control module, it will only display NOT COMMUNICATING. Since the scan tool cannot determine if a given control module should be present or not, the technician is asked in a future step to verify that the vehicle was not built with control modules listed as NOT COMMUNICATING.

   If the scan tool cannot establish communications with ALL of the vehicles control modules, a link to *Data Link References on page 11-232* is provided. A faulty control module or fault with the serial data circuit can cause no communication with all of the control modules on the vehicle. If any control module communicates on the serial data circuit,

continue through the Diagnostic System check, as a future step will address any specific non communicating or group of non communicating control modules.

Once the scan tool has completed the routine, the technician should review each control module that has set a DTC and document them on the Repair Order. When reviewing the DTCs, the technician should take notice if any DTCs are powertrain related, and if so, navigate in the scan tool to the Powertrain area and utilize the Capture Info function. This will upload any Freeze Frame/ Failure Records stored in the control module to the scan tool in case the data is lost from the control module. As an example, if the technician commands a Clear DTCs function on a powertrain controller, all diagnostic information stored in the controller is erased. This includes Freeze Frame/ Failure Records and Inspection/Maintenance System Status indicators, if required for your region.

6. CONTROL MODULE INTERNAL PERFORMANCE FAULTS—The technician is asked to review the DTCs recorded in step 4 and verify there are no control module internal performance faults set current. This type of fault may be the cause of other symptoms or DTCs displayed by the vehicle. By addressing this fault first, the technician may find the other concerns are resolved. The technician should always follow the diagnostic procedure for these types of faults prior to replacing any control module. If the technician finds a control module has an internal performance fault, a link is provided to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92* to select the appropriate DTC diagnostic procedure.

   Examples:

   - B1000 Electronic Control Unit Performance
   - B101D ECU Hardware Performance
   - C0550 Electronic Control Unit Performance
   - C056D ECU Hardware Performance
   - C0570 Auxiliary Electronic Control Unit Performance
   - P0606 Control Module Internal Performance
   - P0607 Control Module Performance

7. CONTROL MODULE COMMUNICATION VERIFICATION—This step is used to ensure the control modules that are NOT COMMUNICATING were not built on the vehicle. To understand if the vehicle was built with that option, we provide a link to the *Data Link References on page 11-232* document where Regular Production Options (RPOs) are listed next to ECU names and can be compared to those the vehicle was built with. If the technician determines that a control that is NOT COMMUNICATING should be present, the technician is asked to follow the appropriate diagnostic procedure listed in the *Data Link References on page 11-232* document.
8. COMMUNICATION and POWERMODE FAULTS—This step is asking the technician to look for communication DTCs or DTCs related to control modules powering up based on power mode, communication enable or wake-up circuits. See in the below table some examples of the DTCs the technician should diagnose prior to continuing through the Diagnostic System Check. The technician should review the list of DTCs recorded in step 4 and verify that none of these type of DTCs are present. If so, the technician is referred to the *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92* to select the appropriate DTC diagnostic procedure.

   Examples:

   - U0140 Lost Communication With Body Control Module
   - U0164 Lost Communication With HVAC Control Module
   - U0170 Lost Communication With Passenger Presence Detection Module
   - U0402 Invalid Data Received From Transmission Control Module
   - U0452 Invalid Data Received From Inflatable Restraint Sensing and Diagnostic Module
   - U1814 Powertrain High Speed Communication Enable Circuit
   - B1428 Ignition Switched Power Run/Crank Relay Circuit
   - B137B Accessory Power Module Wake Up Circuit
   - C0897 Control Module Power Moding
   - P2536 Ignition Accessory Switch Circuit

9. POWER MODE VERIFICATION—This step verifies the Power Mode Master is receiving the proper output state of the push button switch. The technician should use the main power mode input, which is the push button switch. The test should not be performed using a key fob, if the MIL is illuminated the powertrain controller may disable this input. The technician is asked to perform the test with the driver door open. This ensures the retained accessory power mode is inactive during this test which could result in different scan tool readings. The technician is only asked to verify the current Power Mode parameter in the power mode data display list. If the parameter does not match the actual vehicle power mode state, a link is provided to perform the *Power Mode Mismatch on page 11-857* diagnostic procedure.
10. REMAINING DTC REVIEW—Here the technician is asked to review any remaining DTCs that were not addressed in previous steps. The technician is asked first to verify there are no control module supply voltage, system voltage or 5 V circuit DTCs present. Control modules, systems or components with insufficient or zero voltage can cause one or multiple symptoms to exist on the vehicle. Control module voltage issues could also be the cause of failures during a programming event. The technician should correct voltage issues prior to addressing any programming or configuration DTCs. The technician should then check for any ECU programming, setup or configuration DTCs. By programming software or configuring a control module, the technician could correct the customer concern unobtrusively. The remaining DTCs, which are usually specific system or component faults,

are diagnosed last. They can include ECU input and output circuit DTCs or individual circuit faults that usually cause single symptoms or failure modes on the vehicle and can be fixed following the proper DTC diagnostic procedure. In general, the technician should think about what DTCs or faults could be caused by another DTC or fault. A failed sensor may set a component DTC and then the system may set a DTC indicating the system cannot operate properly. By correcting the sensor fault, the system may now operate properly and the system level DTC will transition to history. Refer to the examples within each category below to understand the differences between these DTCs. If DTCs of these type are current, the technician is referred to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92* to choose the correct DTC diagnostic procedure.

10.1. Voltage DTCs
- B1325 Device Power 1 Circuit
- C0875 Device Voltage Reference Input 2 Circuit
- C1001 Adaptive Cruise Control Indicators Supply Voltage Circuit
- P0641 5 V Reference Circuit
- P0787 Downshift Timing Solenoid Control Circuit Low Voltage

10.2. Programming, Setup, Configuration or Software Performance DTCs
- B3943 Steering Column Lock has Not Learned Column Integration Module
- B101E ECU Software Performance
- B1019 System Configuration Error
- C0558 Calibration Data Not Programmed
- P0630 VIN Not Programmed or Mismatched - Powertrain Control Module (PCM)

10.3. Component related DTCs
- B0013 Driver Frontal Deployment Loop Stage 2
- B0163 Passenger Compartment Temp Sensor Circuit
- C0045 Left Rear Wheel Speed Sensor Circuit
- P0565 Cruise Control Switch Circuit
- P0751 1-2 Shift Solenoid (SS) Valve Performance

10.4. System related DTCs
- B1010 System Sensors Data Mismatch
- C0176 System Thermal Error
- C0561 System Disabled Information Stored
- P1564 Vehicle Acceleration Too High – Cruise Control Disabled
- P1625 Transmission Control Module (TCM) System Reset

10.5. Any other remaining DTCs—The technician should diagnose and correct any other DTCs that are left that were not from the categories above.

11. EMISSION RELATED INSPECTION/ MAINTENANCE TESTING CONCERNS—Several regions require that a vehicle pass on-board diagnostic system tests and the inspection/ maintenance emission tests in order to renew license plates or vehicle registration. This is accomplished by viewing the Inspection/ Maintenance System Status display on a scan tool. Using a scan tool, the technician can observe the Inspection/Maintenance System Status in order to verify that the vehicle meets the criteria that comply with the local area requirements. If inspection and maintenance checks are required in your region, and the customer concern is related to not passing an Inspection/Maintenance test, a link is provided to *Inspection/Maintenance System Check on page 6-123* where the technician can choose the appropriate Inspection/Maintenance System Check for the actual engine application being used.
12. SYMPTOM DIAGNOSIS—At this step, the diagnostics are assuming that the only information the technician has available to diagnose the customer concern are symptoms of a problem. There are no DTCs set current or history. There may be a Driver Information Center display message or a system indicator to aid in identifying the root cause. The technician should evaluate the symptoms and conditions described by the customer and perform the symptoms diagnostics for the area of customer concern. A link is provided to *Symptoms - Vehicle on page 6-122* which contains a list of all symptoms related to this service manual publication.

Diagnostic Starting Point - Vehicle

Begin the system diagnosis with *Diagnostic System Check - Vehicle on page 6-91*. The Diagnostic System Check - Vehicle will provide a complete strategy to locate and repair a mechanical or electrical vehicle fault. Not following this strategy may cause additional diagnostic time and/or misdiagnosis.

The Diagnostic System Check - Vehicle will provide the following strategy:
- When to verify the customer concern and identify related bulletins, recalls and preliminary information
- When to identify a control module that is not communicating, a control module that has set a DTC, and the DTC diagnostic priority
- When to address power mode concerns
- When to verify the engine cranks and runs
- When to diagnose symptom related concerns

Diagnostic System Check - Vehicle

Diagnostic Instructions

- Review *Strategy Based Diagnosis on page 6-83* for an overview of the diagnostic approach.
- *Diagnostic System Check Instructions on page 6-87* provides an overview of each diagnostic category.
- Continue through the Diagnostic System Check until you are directed to follow a particular diagnostic or repair procedure. Once a repair has been completed, perform the *Diagnostic Repair Verification on page 6-123* and verify the customer concern has been corrected.

The diagnostic procedures within this manual are developed on the assumption that the following areas function as designed:

- The 12 V battery is fully charged and cables are clean and tight. Refer to *Battery Inspection/Test on page 9-15*.
- Fuses are not open. Refer to *Power Distribution Schematics on page 11-314* and *Electrical Center Identification Views on page 11-430*.
- Ground circuits for the area of customer concern are clean, tight, and in the correct location. Refer to *Ground Distribution Schematics on page 11-333* and *Harness Routing Views on page 11-252*.
- All connections/connectors for the area of concern are fully seated. Refer to *Component Connector End Views on page 11-455*.
- There are no aftermarket devices that affect the operation of the system. Refer to *Checking Aftermarket Accessories on page 11-871*.
- The scan tool powers up. Refer to *Scan Tool Does Not Power Up on page 11-218*.

Diagnostic System Check

1. **VERIFY CUSTOMER CONCERN** - Understand and validate the customer concern. Inspect the visible system components for obvious damage or conditions that may cause the concern.
2. **BULLETIN SEARCH** - Check for related bulletins, recalls/field actions, and preliminary information.
3. **MECHANICAL CONCERNS** - Verify the symptom is not exclusively a mechanical concern.

⇒ **If the symptom is exclusively a mechanical concern**

Refer to *Symptoms - Vehicle on page 6-122*.

⇓ **If the symptom is not a mechanical concern**

Note: Do not clear any DTCs unless instructed to do so by a diagnostic procedure. If any DTC is Powertrain related, select Capture Info to store DTC and Freeze Frame/Failure Records to the scan tool.

4. **VEHICLE POWER UP VERIFICATION** - Vehicle in Service Mode, verify the vehicle powers up.

⇒ **If the vehicle does not power up**

Refer to *Power Mode Mismatch on page 11-857*.

⇓ **If the vehicle powers up**

5. **CONTROL MODULE COMMUNICATION and DTC CHECK** - Using a scan tool, perform the Vehicle DTC Information function and verify at least one control module communicates with the scan tool. Record on the Repair Order the following information:
   - Any control module that is not communicating.
   - Any DTC, including symptom byte, and the control module that has set the DTC.

⇒ **If the scan tool does not communicate with any control module on the vehicle**

Refer to *Data Link References on page 11-232*.

⇓ **If the scan tool communicates with any control module**

6. **CONTROL MODULE INTERNAL PERFORMANCE FAULTS** - Verify there is no current control module Internal Performance DTCs set.

⇒ **If any DTC of this type is set**

Refer to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92*.

⇓ **If no DTC of this type is set**

7. **CONTROL MODULE COMMUNICATION VERIFICATION** - Verify the vehicle is not built with any control module listed as not communicating with the scan tool; refer to *Data Link References on page 11-232*.

⇒ **If the vehicle is built with a control module that is not communicating**

Refer to *Data Link References on page 11-232*.

⇓ **If all control modules the vehicle is built with are communicating**

8. **COMMUNICATION and POWERMODE FAULTS** - Verify there are no current control module Power Mode or Communication DTCs set.

⇒ **If any DTC of this type is set**

Refer to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92*.

⇓ **If no DTC of this type is set**

Note: The electric propulsion system will be active in the vehicle ON state during this test. Ensure the vehicle is out of gear and the parking brake is applied. Turn the vehicle power mode to vehicle OFF as soon as the vehicle ON power mode parameter has been observed.

9. **POWER MODE VERIFICATION** - Driver door open, observe the scan tool Power Mode parameter while cycling the push button switch

through all the power modes. Verify the current Power Mode parameter matches the actual vehicle power mode states.

⇒ **If the Power Mode parameter does not match the vehicle power mode states**

Refer to *Power Mode Mismatch on page 11-857*.

⇓ **If the Power Mode parameter matches the vehicle power mode states**

10. **REMAINING DTC REVIEW** - Verify there are no other DTCs set.

⇒ **If other DTCs are set**

Diagnose them in the order listed below. Refer to *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92*.

10.1. Voltage DTCs

10.2. Programming, Setup or Configuration or Software Performance DTCs

10.3. Component related DTCs

10.4. System related DTCs

10.5. Any remaining DTCs

⇓ **If no other DTCs are set**

11. **EMISSION RELATED INSPECTION/ MAINTENANCE TESTING CONCERNS** - If inspection and maintenance checks are required in your region, verify the customer concern is not related to inspection/maintenance testing.

⇒ **If the customer concern is related to inspection/maintenance testing**

Refer to *Inspection/Maintenance System Check on page 6-123*.

⇓ **If the customer concern is not related to inspection/maintenance testing**

12. **SYMPTOM DIAGNOSIS** - Diagnose any remaining customer concern. Refer to *Symptoms - Vehicle on page 6-122*.

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Action Taken When the DTC Sets – Type A

- The ECM illuminates the malfunction indicator lamp (MIL) as commanded a diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Action Taken When the DTC Sets – Type B

- The control module illuminates the MIL on the second or third consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC – Type A or Type B

- The control module turns OFF the MIL after 3 or 4 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 Drive Cycles where the DTC runs and passes. The Drive Cycle varies by DTC and can be found in the Conditions for Running the DTC.

Action Taken When the DTC Sets – Type C

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The MIL will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC – Type C

- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- A history DTC clears after 40 Drive Cycles where the DTC runs and passes. The drive cycle varies by DTC and can be found in the Conditions for Running the DTC.
- The DTC can be cleared with a scan tool.

Diagnostic Trouble Code (DTC) List - Vehicle

This master DTC list includes all applicable DTCs in alphanumeric order.

Diagnostic Trouble Code (DTC) List - Vehicle

DTC	Diagnostic Procedure
B0012	Supplemental Inflatable Restraints - *DTC B0012 or B0013 on page 12-105*
B0013	Supplemental Inflatable Restraints - *DTC B0012 or B0013 on page 12-105*
B0014	Supplemental Inflatable Restraints - *DTC B0014, B0021, B0031, or B0038 on page 12-109*
B0015	Supplemental Inflatable Restraints - *DTC B0015, B001A, B001B, or B0022 on page 12-113*
B0016	Supplemental Inflatable Restraints - *DTC B0016, B0018, B0023, or B0025 on page 12-117*
B0017	Supplemental Inflatable Restraints - *DTC B0017 or B0024 on page 12-120*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
B0019	Supplemental Inflatable Restraints - *DTC B0019 or B0020 on page 12-123*
B001A	Supplemental Inflatable Restraints - *DTC B0015, B001A, B001B, or B0022 on page 12-113*
B001B	Supplemental Inflatable Restraints - *DTC B0015, B001A, B001B, or B0022 on page 12-113*
B0020	Supplemental Inflatable Restraints - *DTC B0019 or B0020 on page 12-123*
B0021	Supplemental Inflatable Restraints - *DTC B0014, B0021, B0031, or B0038 on page 12-109*
B0022	Supplemental Inflatable Restraints - *DTC B0015, B001A, B001B, or B0022 on page 12-113*
B0023	Supplemental Inflatable Restraints - *DTC B0016, B0018, B0023, or B0025 on page 12-117*
B0024	Supplemental Inflatable Restraints - *DTC B0017 or B0024 on page 12-120*
B0031	Supplemental Inflatable Restraints - *DTC B0014, B0021, B0031, or B0038 on page 12-109*
B0038	Supplemental Inflatable Restraints - *DTC B0014, B0021, B0031, or B0038 on page 12-109*
B0052	Supplemental Inflatable Restraints - *DTC B0052 on page 12-127*
B0071	Supplemental Inflatable Restraints - *DTC B0071 on page 12-128*
B0074	Supplemental Inflatable Restraints - *DTC B0074 on page 12-130*
B0081	Supplemental Inflatable Restraints - *DTC B0081 on page 12-132*
B0082	Seat Belts - *DTC B0082 on page 12-85*
B0083	Supplemental Inflatable Restraints - *DTC B0083-B0088 on page 12-135*
B0084	Supplemental Inflatable Restraints - *DTC B0083-B0088 on page 12-135*
B0085	Supplemental Inflatable Restraints - *DTC B0083-B0088 on page 12-135*
B0086	Supplemental Inflatable Restraints - *DTC B0083-B0088 on page 12-135*
B0087	Supplemental Inflatable Restraints - *DTC B0083-B0088 on page 12-135*
B0088	Supplemental Inflatable Restraints - *DTC B0083-B0088 on page 12-135*
B0091	Supplemental Inflatable Restraints - *DTC B0091 on page 12-139*
B0098	Supplemental Inflatable Restraints - *DTC B0098 on page 12-142*
B010E	Object Detection and Pedestrian Protection - *DTC B010E on page 12-39*
B0158	Displays and Gauges - *DTC B0158 on page 8-81*
B0163	HVAC - Automatic - *DTC B0163 on page 10-88*
B0173	HVAC - Automatic - *DTC B0173, B0178, or B3933 on page 10-90*
B0178	HVAC - Automatic - *DTC B0173, B0178, or B3933 on page 10-90*
B0183	HVAC - Automatic - *DTC B0183 on page 10-96*
B018A	HVAC - Automatic - *DTC B018A, B048C, B048F, or B1395 on page 10-93*
B0193	HVAC - Automatic - *DTC B0193 on page 10-98*
B0223	HVAC - Automatic - *DTC B0223, B0233, B023A, or B0408 on page 10-101*
B0233	HVAC - Automatic - *DTC B0223, B0233, B023A, or B0408 on page 10-101*
B023A	HVAC - Automatic - *DTC B0223, B0233, B023A, or B0408 on page 10-101*
B0283	Fixed and Moveable Windows - *DTC B0283 on page 4-8*
B0408	HVAC - Automatic - *DTC B0223, B0233, B023A, or B0408 on page 10-101*
B0468	HVAC - Automatic - *DTC B0468, B046B, or B046C on page 10-104*
B046A	HVAC - Automatic - *DTC B046A on page 10-107*
B046B	HVAC - Automatic - *DTC B0468, B046B, or B046C on page 10-104*
B046C	HVAC - Automatic - *DTC B0468, B046B, or B046C on page 10-104*
B048C	HVAC - Automatic - *DTC B018A, B048C, B048F, or B1395 on page 10-93*
B048F	HVAC - Automatic - *DTC B018A, B048C, B048F, or B1395 on page 10-93*
B0550	Displays and Gauges - *DTC B0550 on page 8-83*
B096F	Lighting - *DTC B096F on page 4-78*
B097B	Wiring Systems and Power Management - *DTC B097B on page 11-818*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
B1000	Data Communications - *DTC B1000 on page 11-27*
B1001	Data Communications - *DTC B1001 on page 11-28*
B1001	Supplemental Inflatable Restraints - *DTC B1001 on page 12-144*
B1019	Supplemental Inflatable Restraints - *DTC B1019 on page 12-145*
B101D	Data Communications - *DTC B101D on page 11-29*
B101E	Data Communications - *DTC B101E on page 11-30*
B1025	Cellular, Entertainment, and Navigation - *DTC B1025, B1035, B1045, or B1055 on page 8-8*
B1035	Cellular, Entertainment, and Navigation - *DTC B1025, B1035, B1045, or B1055 on page 8-8*
B1045	Cellular, Entertainment, and Navigation - *DTC B1025, B1035, B1045, or B1055 on page 8-8*
B1055	Cellular, Entertainment, and Navigation - *DTC B1025, B1035, B1045, or B1055 on page 8-8*
B124F	Displays and Gauges - *DTC B124F on page 8-84*
B125A	Cellular, Entertainment, and Navigation - *DTC B125A on page 8-10*
B125B	Cellular, Entertainment, and Navigation - *DTC B125B on page 8-12*
B125C	Cellular, Entertainment, and Navigation - *DTC B125C on page 8-14*
B1271	Cellular, Entertainment, and Navigation - *DTC B1271 on page 8-16*
B1325	12 V Starting and Charging - *DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC on page 9-9*
B1330	12 V Starting and Charging - *DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC on page 9-9*
B1370	Wiring Systems and Power Management - *DTC B1370-B1379, B1380-B1389, or B1440-B1443 on page 11-823*
B1370	Wiring Systems and Power Management - Instrument Cluster - *DTC B1370 (Instrument Cluster) on page 11-821*
B1380	Wiring Systems and Power Management - *DTC B1370-B1379, B1380-B1389, or B1440-B1443 on page 11-823*
B1395	Lighting - *DTC B1395 on page 4-80*
B1395	HVAC - Automatic - *DTC B018A, B048C, B048F, or B1395 on page 10-93*
B1405	Secondary and Configurable Customer Controls - *DTC B1405 on page 8-104*
B1441	Wiring Systems and Power Management - *DTC B1370-B1379, B1380-B1389, or B1440-B1443 on page 11-823*
B1445	Wiring Systems and Power Management - *DTC B1445 on page 11-827*
B1446	Cellular, Entertainment, and Navigation - *DTC B1446 or B1447 on page 8-17*
B1447	Cellular, Entertainment, and Navigation - *DTC B1446 or B1447 on page 8-17*
B144A	Wiring Systems and Power Management - *DTC B144A on page 11-829*
B144B	Wiring Systems and Power Management - *DTC B144B on page 11-831*
B1451	Wiring Systems and Power Management - *DTC B1451 on page 11-834*
B147E	Wiring Systems and Power Management - *DTC B147E or B147F on page 11-836*
B147F	Wiring Systems and Power Management - *DTC B147E or B147F on page 11-836*
B1480	Lighting - *DTC B1480 on page 4-83*
B1516	12 V Starting and Charging - *DTC B1516 on page 9-11*
B1517	12 V Starting and Charging - *DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC on page 9-9*
B151A	12 V Starting and Charging - *DTC B151A on page 9-13*
B1527	12 V Starting and Charging - *DTC B1527 on page 9-14*
B1529	Secondary and Configurable Customer Controls - *DTC B1529 on page 8-106*
B2455	Cellular, Entertainment, and Navigation - *DTC B2455 on page 8-19*
B2462	Cellular, Entertainment, and Navigation - *DTC B2462 on page 8-21*
B2470	Cellular, Entertainment, and Navigation - *DTC B2470 on page 8-24*
B2476	Cellular, Entertainment, and Navigation - *DTC B2476 or B2482 on page 8-26*
B2482	Cellular, Entertainment, and Navigation - *DTC B2476 or B2482 on page 8-26*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
B2540	Lighting - *DTC B2540 on page 4-85*
B2545	Lighting - *DTC B2545 on page 4-87*
B2570	Lighting - *DTC B2570 on page 4-89*
B2575	Lighting - *DTC B2575 or B2699 on page 4-91*
B257A	Lighting - *DTC B257A on page 4-94*
B2580	Lighting - *DTC B2580 on page 4-96*
B2585	Lighting - *DTC B2585 or B3867 on page 4-98*
B2610	Lighting - *DTC B2610 on page 4-102*
B2615	Lighting - *DTC B2615 on page 4-105*
B2645	Lighting - *DTC B2645 on page 4-107*
B2652	Lighting - *DTC B2652 on page 4-109*
B2699	Lighting - *DTC B2575 or B2699 on page 4-91*
B270A	Shift Lock Control - *DTC B270A on page 16-100*
B2745	Antilock Brake System - *DTC B2745 on page 5-8*
B2750	Horns - *DTC B2750 on page 4-57*
B2955	Immobilizer - *DTC B2955 on page 12-5*
B3006	Bolted Exterior Body Panels and Closures - *DTC B3006 on page 3-5*
B302A	Immobilizer - *DTC B302A on page 12-7*
B3031	Immobilizer - *DTC B3031 on page 12-9*
B3055	Immobilizer - *DTC B3055 on page 12-10*
B305C	Immobilizer - *DTC B305C on page 12-12*
B3060	Immobilizer - *DTC B3060 on page 12-13*
B3101	Remote Functions - *DTC B3101 on page 12-57*
B3105	Remote Functions - *DTC B3105 on page 12-59*
B3106	Remote Functions - *DTC B3106 on page 12-60*
B3109	Remote Functions - *DTC B3109-B3113 on page 12-61*
B310D	Remote Functions - *DTC B310D-B310F on page 12-62*
B310E	Remote Functions - *DTC B310D-B310F on page 12-62*
B310F	Remote Functions - *DTC B310D-B310F on page 12-62*
B3110	Remote Functions - *DTC B3109-B3113 on page 12-61*
B3111	Remote Functions - *DTC B3109-B3113 on page 12-61*
B3112	Remote Functions - *DTC B3109-B3113 on page 12-61*
B3113	Remote Functions - *DTC B3109-B3113 on page 12-61*
B3122	Remote Functions - *DTC B3122 on page 12-63*
B3123	Remote Functions - *DTC B3123 on page 12-65*
B3125	Vehicle Access - *DTC B3125, B3130, or B3135 (With AU3) on page 4-222* or *DTC B3125, B3130, or B3135 (Without AU3) on page 4-226*
B3130	Vehicle Access - *DTC B3125, B3130, or B3135 (With AU3) on page 4-222* or *DTC B3125, B3130, or B3135 (Without AU3) on page 4-226*
B3135	Vehicle Access - *DTC B3125, B3130, or B3135 (With AU3) on page 4-222* or *DTC B3125, B3130, or B3135 (Without AU3) on page 4-226*
B3140	Vehicle Access - *DTC B3140 or B3150 (With AU3) on page 4-229* or *DTC B3140 or B3150 (Without AU3) on page 4-233*
B3150	Vehicle Access - *DTC B3140 or B3150 (With AU3) on page 4-229* or *DTC B3140 or B3150 (Without AU3) on page 4-233*
B3567	Displays and Gauges - *Driver Information Center Switch Malfunction - DTC B3567 on page 8-86*
B3588	Lighting - *DTC B3588 on page 4-111*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
B3596	Lighting - *DTC B3596 on page 4-113*
B3600	Lighting - *DTC B3600 on page 4-115*
B3622	Secondary and Configurable Customer Controls - *DTC B3622 on page 8-108*
B3650	Lighting - *DTC B3650 on page 4-117*
B370B	Wipers and Washers - *DTC B370B on page 4-290*
B3715	Wipers and Washers - *DTC B3715 or B3875 on page 4-294*
B3794	Cruise Control - *Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C on page 9-45*
B3806	Lighting - *DTC B3806 on page 4-119*
B3811	Wipers and Washers - *DTC B3811 on page 4-298*
B3867	Lighting - *DTC B2585 or B3867 on page 4-98*
B3873	Wipers and Washers - *DTC B3873 on page 4-301*
B3875	Wipers and Washers - *DTC B3715 or B3875 on page 4-294*
B3881	Lighting - *DTC B3881 or B3882 on page 4-121*
B3882	Lighting - *DTC B3881 or B3882 on page 4-121*
B3883	Lighting - *DTC B3883 on page 4-125*
B3884	Lighting - *DTC B3884 on page 4-127*
B389A	Immobilizer - *DTC B389A on page 12-14*
B3902	Immobilizer - *DTC B3902 on page 12-16*
B3933	HVAC - Automatic - *DTC B0173, B0178, or B3933 on page 10-90*
B3935	Immobilizer - *DTC B3935 on page 12-17*
B3948	Lighting - *DTC B3948 or B3949 on page 4-129*
B3949	Lighting - *DTC B3948 or B3949 on page 4-129*
B3950	Lighting - *DTC B3950 or B3951 on page 4-133*
B3951	Lighting - *DTC B3950 or B3951 on page 4-133*
B3976	Immobilizer - *DTC B3976 on page 12-18*
B3984	Immobilizer - *DTC B3984 on page 12-19*
C0035	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C0036	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C0037	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C0038	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C0039	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C0040	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C0041	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C0042	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C0043	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C0044	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C0045	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C0046	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C0047	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C0048	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C0049	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C0050	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C005A	Antilock Brake System - *DTC C005A on page 5-14*
C0110	Antilock Brake System - *DTC C0110, C12E0, C12E8, or C12E9 on page 5-15*
C012A	Antilock Brake System - *DTC C012A, C128B, C128E, or C12B2-C12B4 on page 5-17*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
C012B	Antilock Brake System - *DTC C012B or C12B6-C12B8 on page 5-19*
C012D	Antilock Brake System - *DTC C012D, C120A, C128A, C128D, C12BC, C12BD, or C12BE on page 5-21*
C012E	Antilock Brake System - *DTC C012E or C12FE on page 5-23*
C012F	Antilock Brake System - *DTC C012F, C12A7, or C12DD on page 5-25*
C0161	Antilock Brake System - *DTC C0161 on page 5-27*
C0176	Power Steering - *DTC C0176 on page 14-5*
C0186	Antilock Brake System - *DTC C0186, C0187, C0196, or C0287 on page 5-29*
C0187	Antilock Brake System - *DTC C0186, C0187, C0196, or C0287 on page 5-29*
C0196	Antilock Brake System - *DTC C0186, C0187, C0196, or C0287 on page 5-29*
C0201	Antilock Brake System - *DTC C0201 on page 5-31*
C0242	Antilock Brake System - *DTC C0242 or P0856 on page 5-33*
C0245	Antilock Brake System - *DTC C0245, C122E on page 5-34*
C0256	Antilock Brake System - *DTC C0256, C12E6, or C12E7 on page 5-36*
C0267	Hydraulic Brakes - *DTC C0267 on page 5-135*
C0277	Lighting - *DTC C0277 or C0890 on page 4-137*
C027D	Park Brake - *DTC C027D on page 5-224*
C0287	Antilock Brake System - *DTC C0186, C0187, C0196, or C0287 on page 5-29*
C028A	Park Brake - *DTC C028A, C028B, or C028F on page 5-222*
C028B	Park Brake - *DTC C028A, C028B, or C028F on page 5-222*
C028E	Park Brake - *DTC C028E on page 5-225*
C028F	Park Brake - *DTC C028A, C028B, or C028F on page 5-222*
C0293	Park Brake - *DTC C0293 on page 5-227*
C0294	Antilock Brake System - *DTC C0294, C120C, or C12F8 on page 5-38*
C0297	Lighting - *DTC C0297 on page 4-140*
C0298	Park Brake - *DTC C0298 on page 5-230*
C0299	Antilock Brake System - *DTC C0299 or C12FF on page 5-42*
C029C	Antilock Brake System - *DTC C029C, C120C, C129A-C129F, C12B1, or C12F8 on page 5-44*
C0460	Power Steering - *DTC C0460 on page 14-7*
C0475	Power Steering - *DTC C0475 on page 14-8*
C0545	Power Steering - *DTC C0545 on page 14-9*
C0552	Antilock Brake System - *DTC C0552 or C121D on page 5-48*
C0558	Park Brake - *DTC C0558 on page 5-233*
C0561	Antilock Brake System - *DTC C0561 on page 5-50*
C0561	Park Brake - *DTC C0561 on page 5-235*
C0569	Tire Pressure Monitoring - *DTC C0569 on page 15-38*
C056D	Antilock Brake System - *DTC C056D, C127A-C127C, C12E9, C12F2-C12F6, or C12FE on page 5-52*
C056D	Park Brake - *DTC C056D on page 5-236*
C056D	Data Communications - *DTC C056D on page 11-31*
C056E	Antilock Brake System - *DTC C056E on page 5-54*
C056E	Park Brake - *DTC C056E on page 5-238*
C056E	Data Communications - *DTC C056E on page 11-32*
C0574	Antilock Brake System - *DTC C0574 on page 5-55*
C0574	Park Brake - *DTC C0574 on page 5-240*
C0710	Antilock Brake System - *DTC C0710 on page 5-56*
C0750	Tire Pressure Monitoring - *DTC C0750, C0755, C0760, or C0765 on page 15-39*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
C0755	Tire Pressure Monitoring - *DTC C0750, C0755, C0760, or C0765 on page 15-39*
C0760	Tire Pressure Monitoring - *DTC C0750, C0755, C0760, or C0765 on page 15-39*
C0765	Tire Pressure Monitoring - *DTC C0750, C0755, C0760, or C0765 on page 15-39*
C0775	Tire Pressure Monitoring - *DTC C0775 on page 15-41*
C0800	12 V Starting and Charging - *DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC on page 9-9*
C0847	Wiring Systems and Power Management - *DTC C0847, C0848, C1240, or C1241 on page 11-840*
C0848	Wiring Systems and Power Management - *DTC C0847, C0848, C1240, or C1241 on page 11-840*
C0857	Wiring Systems and Power Management - *DTC C0857 or C1242 on page 11-842*
C0870	Antilock Brake System - *DTC C0870 or C12E4 on page 5-58*
C0880	Antilock Brake System - *DTC C0880, C12E5, or C120F on page 5-59*
C0890	Lighting - *DTC C0277 or C0890 on page 4-137*
C0898	Antilock Brake System - *DTC C0898 on page 5-61*
C0899	12 V Starting and Charging - *DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC on page 9-9*
C0900	12 V Starting and Charging - *DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC on page 9-9*
C1120	Antilock Brake System - *DTC C1120 or C1121 on page 5-63*
C1121	Antilock Brake System - *DTC C1120 or C1121 on page 5-63*
C1122	Antilock Brake System - *DTC C1122 or C1123 on page 5-65*
C1123	Antilock Brake System - *DTC C1122 or C1123 on page 5-65*
C1124	Antilock Brake System - *DTC C1124 or C1125 on page 5-67*
C1125	Antilock Brake System - *DTC C1124 or C1125 on page 5-67*
C1207	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C1208	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C1209	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C120A	Antilock Brake System - *DTC C012D, C120A, C128A, C128D, C12BC, C12BD, or C12BE on page 5-21*
C120C	Antilock Brake System - *DTC C0294, C120C, or C12F8 on page 5-38*
C120C	Antilock Brake System - *DTC C029C, C120C, C129A-C129F, C12B1, or C12F8 on page 5-44*
C120F	Antilock Brake System - *DTC C0880, C12E5, or C120F on page 5-59*
C1210	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C121D	Antilock Brake System - *DTC C0552 or C121D on page 5-48*
C1221	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C1222	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C1223	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C1224	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C1225	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C1226	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C1227	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C1228	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C122E	Antilock Brake System - *DTC C0245, C122E on page 5-34*
C1232	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C1233	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C1234	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C1235	Antilock Brake System - *DTC C0035-C0050, C1207-C1210, C1221-C1228, or C1232-C1235 on page 5-10*
C1240	Wiring Systems and Power Management - *DTC C0847, C0848, C1240, or C1241 on page 11-840*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
C1241	Wiring Systems and Power Management - *DTC C0847, C0848, C1240, or C1241 on page 11-840*
C1242	Wiring Systems and Power Management - *DTC C0857 or C1242 on page 11-842*
C127A	Antilock Brake System - *DTC C056D, C127A-C127C, C12E9, C12F2-C12F6, or C12FE on page 5-52*
C127B	Antilock Brake System - *DTC C056D, C127A-C127C, C12E9, C12F2-C12F6, or C12FE on page 5-52*
C127C	Antilock Brake System - *DTC C056D, C127A-C127C, C12E9, C12F2-C12F6, or C12FE on page 5-52*
C1280	Park Brake - *DTC C1280 or C1281 on page 5-242*
C1281	Park Brake - *DTC C1280 or C1281 on page 5-242*
C128A	Antilock Brake System - *DTC C012D, C120A, C128A, C128D, C12BC, C12BD, or C12BE on page 5-21*
C128B	Antilock Brake System - *DTC C012A, C128B, C128E, or C12B2-C12B4 on page 5-17*
C128D	Antilock Brake System - *DTC C012D, C120A, C128A, C128D, C12BC, C12BD, or C12BE on page 5-21*
C128E	Antilock Brake System - *DTC C012A, C128B, C128E, or C12B2-C12B4 on page 5-17*
C129A	Antilock Brake System - *DTC C029C, C120C, C129A-C129F, C12B1, or C12F8 on page 5-44*
C129B	Antilock Brake System - *DTC C029C, C120C, C129A-C129F, C12B1, or C12F8 on page 5-44*
C129C	Antilock Brake System - *DTC C029C, C120C, C129A-C129F, C12B1, or C12F8 on page 5-44*
C129D	Antilock Brake System - *DTC C029C, C120C, C129A-C129F, C12B1, or C12F8 on page 5-44*
C129E	Antilock Brake System - *DTC C029C, C120C, C129A-C129F, C12B1, or C12F8 on page 5-44*
C129F	Antilock Brake System - *DTC C029C, C120C, C129A-C129F, C12B1, or C12F8 on page 5-44*
C12A7	Antilock Brake System - *DTC C012F, C12A7, or C12DD on page 5-25*
C12B1	Antilock Brake System - *DTC C029C, C120C, C129A-C129F, C12B1, or C12F8 on page 5-44*
C12B2	Antilock Brake System - *DTC C012A, C128B, C128E, or C12B2-C12B4 on page 5-17*
C12B3	Antilock Brake System - *DTC C012A, C128B, C128E, or C12B2-C12B4 on page 5-17*
C12B4	Antilock Brake System - *DTC C012A, C128B, C128E, or C12B2-C12B4 on page 5-17*
C12B6	Antilock Brake System - *DTC C012B or C12B6-C12B8 on page 5-19*
C12B7	Antilock Brake System - *DTC C012B or C12B6-C12B8 on page 5-19*
C12B8	Antilock Brake System - *DTC C012B or C12B6-C12B8 on page 5-19*
C12BC	Antilock Brake System - *DTC C012D, C120A, C128A, C128D, C12BC, C12BD, or C12BE on page 5-21*
C12BD	Antilock Brake System - *DTC C012D, C120A, C128A, C128D, C12BC, C12BD, or C12BE on page 5-21*
C12BE	Antilock Brake System - *DTC C012D, C120A, C128A, C128D, C12BC, C12BD, or C12BE on page 5-21*
C12DD	Antilock Brake System - *DTC C012F, C12A7, or C12DD on page 5-25*
C12E0	Antilock Brake System - *DTC C0110, C12E0, C12E8, or C12E9 on page 5-15*
C12E1	12 V Starting and Charging - *DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC on page 9-9*
C12E2	12 V Starting and Charging - *DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC on page 9-9*
C12E4	Antilock Brake System - *DTC C0870 or C12E4 on page 5-58*
C12E5	Antilock Brake System - *DTC C0880, C12E5, or C120F on page 5-59*
C12E6	Antilock Brake System - *DTC C0256, C12E6, or C12E7 on page 5-36*
C12E7	Antilock Brake System - *DTC C0256, C12E6, or C12E7 on page 5-36*
C12E8	Antilock Brake System - *DTC C0110, C12E0, C12E8, or C12E9 on page 5-15*
C12E9	Antilock Brake System - *DTC C056D, C127A-C127C, C12E9, C12F2-C12F6, or C12FE on page 5-52*
C12E9	Antilock Brake System - *DTC C0110, C12E0, C12E8, or C12E9 on page 5-15*
C12F2	Antilock Brake System - *DTC C056D, C127A-C127C, C12E9, C12F2-C12F6, or C12FE on page 5-52*
C12F3	Antilock Brake System - *DTC C056D, C127A-C127C, C12E9, C12F2-C12F6, or C12FE on page 5-52*
C12F4	Antilock Brake System - *DTC C056D, C127A-C127C, C12E9, C12F2-C12F6, or C12FE on page 5-52*
C12F5	Antilock Brake System - *DTC C056D, C127A-C127C, C12E9, C12F2-C12F6, or C12FE on page 5-52*
C12F6	Antilock Brake System - *DTC C056D, C127A-C127C, C12E9, C12F2-C12F6, or C12FE on page 5-52*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
C12F8	Antilock Brake System - *DTC C0294, C120C, or C12F8 on page 5-38*
C12F8	Antilock Brake System - *DTC C029C, C120C, C129A-C129F, C12B1, or C12F8 on page 5-44*
C12FE	Antilock Brake System - *DTC C012E or C12FE on page 5-23*
C12FE	Antilock Brake System - *DTC C056D, C127A-C127C, C12E9, C12F2-C12F6, or C12FE on page 5-52*
C12FF	Antilock Brake System - *DTC C0299 or C12FF on page 5-42*
P0071	HVAC - Automatic - *DTC P0071-P0073 on page 10-109*
P0072	HVAC - Automatic - *DTC P0071-P0073 on page 10-109*
P0073	HVAC - Automatic - *DTC P0071-P0073 on page 10-109*
P0480	Hybrid/EV Battery Heating and Cooling - *DTC P0480 on page 9-205*
P0513	Immobilizer - *DTC P0513 on page 12-20*
P0532	HVAC - Automatic - *DTC P0532 or P0533 on page 10-112*
P0533	HVAC - Automatic - *DTC P0532 or P0533 on page 10-112*
P0534	HVAC - Automatic - *DTC P0534 on page 10-114*
P0562	12 V Starting and Charging - *DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC on page 9-9*
P0563	12 V Starting and Charging - *DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC on page 9-9*
P0564	Cruise Control - *Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C on page 9-45*
P0565	Cruise Control - *Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C on page 9-45*
P0567	Cruise Control - *Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C on page 9-45*
P0568	Cruise Control - *Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C on page 9-45*
P056C	Cruise Control - *Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C on page 9-45*
P0572	Cruise Control - *DTC P0572 or P0573 on page 9-40*
P0573	Cruise Control - *DTC P0572 or P0573 on page 9-40*
P0575	Cruise Control - *DTC P0575 on page 9-42*
P0580	Cruise Control - *Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C on page 9-45*
P0581	Cruise Control - *Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C on page 9-45*
P059F	Bumpers and Fascias - *DTC P059F or P151E on page 3-49*
P0601	Hybrid/EV Controls - Hybrid Powertrain Control Module 1 - *DTC P0601-P0606, P060A, P062F, or P262B (Hybrid Powertrain Control Module 1) on page 9-65*
P0601	Hybrid/EV Controls - ECM - *DTC P0601-P0604, P0606, P062F, P0630, P16F3, or P262B (ECM) on page 9-67*
P0601	Data Communications - *DTC P0601-P0606, P060A, P062F, or P262B on page 11-33*
P0602	Hybrid/EV Controls - Hybrid Powertrain Control Module 1 - *DTC P0601-P0606, P060A, P062F, or P262B (Hybrid Powertrain Control Module 1) on page 9-65*
P0602	Hybrid/EV Controls - ECM - *DTC P0601-P0604, P0606, P062F, P0630, P16F3, or P262B (ECM) on page 9-67*
P0602	Data Communications - *DTC P0601-P0606, P060A, P062F, or P262B on page 11-33*
P0603	Hybrid/EV Controls - Hybrid Powertrain Control Module 1 - *DTC P0601-P0606, P060A, P062F, or P262B (Hybrid Powertrain Control Module 1) on page 9-65*
P0603	Hybrid/EV Controls - ECM - *DTC P0601-P0604, P0606, P062F, P0630, P16F3, or P262B (ECM) on page 9-67*
P0603	Data Communications - *DTC P0601-P0606, P060A, P062F, or P262B on page 11-33*
P0604	Hybrid/EV Controls - Hybrid Powertrain Control Module 1 - *DTC P0601-P0606, P060A, P062F, or P262B (Hybrid Powertrain Control Module 1) on page 9-65*
P0604	Hybrid/EV Controls - ECM - *DTC P0601-P0604, P0606, P062F, P0630, P16F3, or P262B (ECM) on page 9-67*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
P0604	Data Communications - *DTC P0601-P0606, P060A, P062F, or P262B on page 11-33*
P0605	Hybrid/EV Controls - *DTC P0601-P0606, P060A, P062F, or P262B (Hybrid Powertrain Control Module 1) on page 9-65*
P0605	Data Communications - *DTC P0601-P0606, P060A, P062F, or P262B on page 11-33*
P0606	Hybrid/EV Controls - Hybrid Powertrain Control Module 1 - *DTC P0601-P0606, P060A, P062F, or P262B (Hybrid Powertrain Control Module 1) on page 9-65*
P0606	Data Communications - *DTC P0601-P0606, P060A, P062F, or P262B on page 11-33*
P0606	Hybrid/EV Controls - ECM - *DTC P0601-P0604, P0606, P062F, P0630, P16F3, or P262B (ECM) on page 9-67*
P060A	Hybrid/EV Controls - *DTC P0601-P0606, P060A, P062F, or P262B (Hybrid Powertrain Control Module 1) on page 9-65*
P060A	Data Communications - *DTC P0601-P0606, P060A, P062F, or P262B on page 11-33*
P061A	Hybrid/EV Controls - *DTC P061A or P061B on page 9-69*
P061B	Hybrid/EV Controls - *DTC P061A or P061B on page 9-69*
P062F	Hybrid/EV Controls - Hybrid Powertrain Control Module 1 - *DTC P0601-P0606, P060A, P062F, or P262B (Hybrid Powertrain Control Module 1) on page 9-65*
P062F	Hybrid/EV Controls - ECM - *DTC P0601-P0604, P0606, P062F, P0630, P16F3, or P262B (ECM) on page 9-67*
P062F	Data Communications - *DTC P0601-P0606, P060A, P062F, or P262B on page 11-33*
P0630	Hybrid/EV Controls - *DTC P0601-P0604, P0606, P062F, P0630, P16F3, or P262B (ECM) on page 9-67*
P0633	Immobilizer - *DTC P0633 on page 12-21*
P0641	Hybrid/EV Controls - *DTC P0641, P0697, or P06A3 on page 9-70*
P0650	Hybrid/EV Controls - *DTC P0650, P263A, or P263B on page 9-72*
P0697	Hybrid/EV Controls - *DTC P0641, P0697, or P06A3 on page 9-70*
P06A3	Hybrid/EV Controls - *DTC P0641, P0697, or P06A3 on page 9-70*
P06AF	Hybrid/EV Controls - *DTC P06AF on page 9-74*
P06B1	Hybrid/EV Controls - *DTC P06B1, P06B2, P06E7, or P06E8 on page 9-76*
P06B2	Hybrid/EV Controls - *DTC P06B1, P06B2, P06E7, or P06E8 on page 9-76*
P06E4	Data Communications - *DTC P06E4 on page 11-35*
P06E7	Hybrid/EV Controls - *DTC P06B1, P06B2, P06E7, or P06E8 on page 9-76*
P06E8	Hybrid/EV Controls - *DTC P06B1, P06B2, P06E7, or P06E8 on page 9-76*
P0703	Cruise Control - *DTC P0703 on page 9-43*
P0711	Automatic Transmission - 1ET35 - *DTC P0711-P0713 on page 16-18*
P0712	Automatic Transmission - 1ET35 - *DTC P0711-P0713 on page 16-18*
P0713	Automatic Transmission - 1ET35 - *DTC P0711-P0713 on page 16-18*
P0856	Antilock Brake System - *DTC C0242 or P0856 on page 5-33*
P0A0C	Hybrid/EV Energy Storage - *DTC P0A0C or P0A0D on page 9-373*
P0A0D	Hybrid/EV Energy Storage - *DTC P0A0C or P0A0D on page 9-373*
P0A1B	Hybrid/EV Controls - *DTC P0A1B on page 9-77*
P0A1F	Data Communications - *DTC P0A1F, P1A01, P1A05, or P1A06 on page 11-38*
P0A3F	Hybrid/EV Controls - *DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03 on page 9-78*
P0A40	Hybrid/EV Controls - *DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03 on page 9-78*
P0A5E	Hybrid/EV Controls - *DTC P0A5E, P0A61, or P0A64 on page 9-82*
P0A61	Hybrid/EV Controls - *DTC P0A5E, P0A61, or P0A64 on page 9-82*
P0A64	Hybrid/EV Controls - *DTC P0A5E, P0A61, or P0A64 on page 9-82*
P0A78	Hybrid/EV Controls - *DTC P0A78 on page 9-83*
P0A7E	Hybrid/EV Battery Heating and Cooling - *DTC P0A7E on page 9-207*
P0A7F	Hybrid/EV Energy Storage - *DTC P0A7F on page 9-376*
P0A8D	Hybrid/EV Controls - *DTC P0A8D on page 9-85*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
P0A9C	Hybrid/EV Battery Heating and Cooling - *DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36 on page 9-209*
P0A9D	Hybrid/EV Battery Heating and Cooling - *DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36 on page 9-209*
P0A9E	Hybrid/EV Battery Heating and Cooling - *DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36 on page 9-209*
P0AA1	Hybrid/EV Energy Storage - *DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE2, P0AE4, P0D0A, P0D11, P1EBC, P1EBE-P1EC0, or P1EC3-P1EC5 on page 9-378*
P0AA4	Hybrid/EV Energy Storage - *DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE2, P0AE4, P0D0A, P0D11, P1EBC, P1EBE-P1EC0, or P1EC3-P1EC5 on page 9-378*
P0AA6	Hybrid/EV Energy Storage - *DTC P0AA6, P0DAA, P1AE6, or P1F0E on page 9-392*
P0ABB	Hybrid/EV Energy Storage - *DTC P0ABB, P0ABC, or P0ABD on page 9-395*
P0ABC	Hybrid/EV Energy Storage - *DTC P0ABB, P0ABC, or P0ABD on page 9-395*
P0ABD	Hybrid/EV Energy Storage - *DTC P0ABB, P0ABC, or P0ABD on page 9-395*
P0AC4	Hybrid/EV Controls - *DTC P0AC4 on page 9-86*
P0AC6	Hybrid/EV Battery Heating and Cooling - *DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36 on page 9-209*
P0AC7	Hybrid/EV Battery Heating and Cooling - *DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36 on page 9-209*
P0AC8	Hybrid/EV Battery Heating and Cooling - *DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36 on page 9-209*
P0ACB	Hybrid/EV Battery Heating and Cooling - *DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36 on page 9-209*
P0ACC	Hybrid/EV Battery Heating and Cooling - *DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36 on page 9-209*
P0ACD	Hybrid/EV Battery Heating and Cooling - *DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36 on page 9-209*
P0AD9	Hybrid/EV Energy Storage - *DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE2, P0AE4, P0D0A, P0D11, P1EBC, P1EBE-P1EC0, or P1EC3-P1EC5 on page 9-378*
P0ADD	Hybrid/EV Energy Storage - *DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE2, P0AE4, P0D0A, P0D11, P1EBC, P1EBE-P1EC0, or P1EC3-P1EC5 on page 9-378*
P0AE2	Hybrid/EV Energy Storage - *DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE2, P0AE4, P0D0A, P0D11, P1EBC, P1EBE-P1EC0, or P1EC3-P1EC5 on page 9-378*
P0AE4	Hybrid/EV Energy Storage - *DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE2, P0AE4, P0D0A, P0D11, P1EBC, P1EBE-P1EC0, or P1EC3-P1EC5 on page 9-378*
P0AE9	Hybrid/EV Battery Heating and Cooling - *DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36 on page 9-209*
P0AEA	Hybrid/EV Battery Heating and Cooling - *DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36 on page 9-209*
P0AEB	Hybrid/EV Battery Heating and Cooling - *DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36 on page 9-209*
P0AEE	Hybrid/EV Controls - *DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, or P0BDC-P0BDE on page 9-87*
P0AEF	Hybrid/EV Controls - *DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, or P0BDC-P0BDE on page 9-87*
P0AF0	Hybrid/EV Controls - *DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, or P0BDC-P0BDE on page 9-87*
P0AF8	Hybrid/EV Energy Storage - *DTC P0AF8 on page 9-398*
P0AF8	HVAC - Automatic - *DTC P0AF8 on page 10-121*
P0AFA	Hybrid/EV Energy Storage - *DTC P0AFA or P0AFB on page 9-401*
P0AFB	Hybrid/EV Energy Storage - *DTC P0AFA or P0AFB on page 9-401*
P0B01	Hybrid/EV Controls - *DTC P0B01, P0B04, or P0B07 on page 9-89*
P0B04	Hybrid/EV Controls - *DTC P0B01, P0B04, or P0B07 on page 9-89*
P0B07	Hybrid/EV Controls - *DTC P0B01, P0B04, or P0B07 on page 9-89*
P0B0D	Hybrid/EV Controls - *DTC P0B0D on page 9-91*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
P0B10	Hybrid/EV Energy Storage - *DTC P0B10, P0B11, or P0B13 on page 9-405*
P0B11	Hybrid/EV Energy Storage - *DTC P0B10, P0B11, or P0B13 on page 9-405*
P0B13	Hybrid/EV Energy Storage - *DTC P0B10, P0B11, or P0B13 on page 9-405*
P0B3B–P0BBB	Hybrid/EV Energy Storage - *DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B on page 9-408*
P0BC3	Hybrid/EV Battery Heating and Cooling - *DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36 on page 9-209*
P0BC4	Hybrid/EV Battery Heating and Cooling - *DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36 on page 9-209*
P0BC5	Hybrid/EV Battery Heating and Cooling - *DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36 on page 9-209*
P0BD2	Hybrid/EV Controls - *DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, or P0BDC-P0BDE on page 9-87*
P0BD3	Hybrid/EV Controls - *DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, or P0BDC-P0BDE on page 9-87*
P0BD4	Hybrid/EV Controls - *DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, or P0BDC-P0BDE on page 9-87*
P0BDC	Hybrid/EV Controls - *DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, or P0BDC-P0BDE on page 9-87*
P0BDD	Hybrid/EV Controls - *DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, or P0BDC-P0BDE on page 9-87*
P0BDE	Hybrid/EV Controls - *DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, or P0BDC-P0BDE on page 9-87*
P0BE6	Hybrid/EV Controls - *DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, or P0BF0 on page 9-92*
P0BE7	Hybrid/EV Controls - *DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, or P0BF0 on page 9-92*
P0BE8	Hybrid/EV Controls - *DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, or P0BF0 on page 9-92*
P0BEA	Hybrid/EV Controls - *DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, or P0BF0 on page 9-92*
P0BEB	Hybrid/EV Controls - *DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, or P0BF0 on page 9-92*
P0BEC	Hybrid/EV Controls - *DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, or P0BF0 on page 9-92*
P0BEE	Hybrid/EV Controls - *DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, or P0BF0 on page 9-92*
P0BEF	Hybrid/EV Controls - *DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, or P0BF0 on page 9-92*
P0BF0	Hybrid/EV Controls - *DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, or P0BF0 on page 9-92*
P0BFD	Hybrid/EV Controls - *DTC P0BFD on page 9-93*
P0C01	Hybrid/EV Controls - *DTC P0C01 on page 9-95*
P0C0B	Hybrid/EV Controls - *DTC P0C0B on page 9-97*
P0C11	Hybrid/EV Controls - *DTC P0C11-P0C13 on page 9-98*
P0C12	Hybrid/EV Controls - *DTC P0C11-P0C13 on page 9-98*
P0C13	Hybrid/EV Controls - *DTC P0C11-P0C13 on page 9-98*
P0C17	Hybrid/EV Controls - *DTC P0C17 or P1B0F on page 9-100*
P0C19	Hybrid/EV Controls - *DTC P0C19 on page 9-103*
P0C28	Hybrid/EV Controls - *DTC P0C28 on page 9-104*
P0C34	Hybrid/EV Battery Heating and Cooling - *DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36 on page 9-209*
P0C35	Hybrid/EV Battery Heating and Cooling - *DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36 on page 9-209*
P0C36	Hybrid/EV Battery Heating and Cooling - *DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36 on page 9-209*
P0C43	Hybrid/EV Battery Heating and Cooling - *DTC P0C43-P0C45 on page 9-212*
P0C44	Hybrid/EV Battery Heating and Cooling - *DTC P0C43-P0C45 on page 9-212*
P0C45	Hybrid/EV Battery Heating and Cooling - *DTC P0C43-P0C45 on page 9-212*
P0C47	Hybrid/EV Battery Heating and Cooling - *DTC P0C47, P0C4A, P1E8C, or P1E8D on page 9-215*
P0C4A	Hybrid/EV Battery Heating and Cooling - *DTC P0C47, P0C4A, P1E8C, or P1E8D on page 9-215*
P0C4E	Hybrid/EV Controls - *DTC P0C4E on page 9-105*
P0C52	Hybrid/EV Controls - *DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03 on page 9-78*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
P0C53	Hybrid/EV Controls - *DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03 on page 9-78*
P0C5C	Hybrid/EV Controls - *DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03 on page 9-78*
P0C5D	Hybrid/EV Controls - *DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03 on page 9-78*
P0C76	Hybrid/EV Controls - *DTC P0C76 on page 9-107*
P0C77	Hybrid/EV Energy Storage - *DTC P0C77 or P0C78 on page 9-412*
P0C78	Hybrid/EV Energy Storage - *DTC P0C77 or P0C78 on page 9-412*
P0CCC	Vehicle Access - *DTC P0CCC, P0CCE, or P0CCF on page 4-236*
P0CCE	Vehicle Access - *DTC P0CCC, P0CCE, or P0CCF on page 4-236*
P0CCF	Vehicle Access - *DTC P0CCC, P0CCE, or P0CCF on page 4-236*
P0CD6	Hybrid/EV Battery Heating and Cooling - *DTC P0CD6-P0CD8 on page 9-219*
P0CD7	Hybrid/EV Battery Heating and Cooling - *DTC P0CD6-P0CD8 on page 9-219*
P0CD8	Hybrid/EV Battery Heating and Cooling - *DTC P0CD6-P0CD8 on page 9-219*
P0CE2	Hybrid/EV Battery Heating and Cooling - *DTC P0CE2, P0CE3, P1EC7, P1EC8, or P1F56 on page 9-222*
P0CE3	Hybrid/EV Battery Heating and Cooling - *DTC P0CE2, P0CE3, P1EC7, P1EC8, or P1F56 on page 9-222*
P0CE5	Hybrid/EV Battery Heating and Cooling - *DTC P0CE5-P0CE7 and P1F58 on page 9-225*
P0CE6	Hybrid/EV Battery Heating and Cooling - *DTC P0CE5-P0CE7 and P1F58 on page 9-225*
P0CE7	Hybrid/EV Battery Heating and Cooling - *DTC P0CE5-P0CE7 and P1F58 on page 9-225*
P0CE9	Hybrid/EV Battery Heating and Cooling - *DTC P0CE9, P0CEA, P1F44, or P1F45 on page 9-228*
P0CEA	Hybrid/EV Battery Heating and Cooling - *DTC P0CE9, P0CEA, P1F44, or P1F45 on page 9-228*
P0CEF	Hybrid/EV Battery Heating and Cooling - *DTC P0CEF-P0CF1 on page 9-231*
P0CF0	Hybrid/EV Battery Heating and Cooling - *DTC P0CEF-P0CF1 on page 9-231*
P0CF1	Hybrid/EV Battery Heating and Cooling - *DTC P0CEF-P0CF1 on page 9-231*
P0CF4	Plug-In Charging - *DTC P0CF4-P0CF6 on page 9-558*
P0CF5	Plug-In Charging - *DTC P0CF4-P0CF6 on page 9-558*
P0CF6	Plug-In Charging - *DTC P0CF4-P0CF6 on page 9-558*
P0CF9	Plug-In Charging - *DTC P0CF9 or P0D01 on page 9-561*
P0D01	Plug-In Charging - *DTC P0CF9 or P0D01 on page 9-561*
P0D0A	Hybrid/EV Energy Storage - *DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE2, P0AE4, P0D0A, P0D11, P1EBC, P1EBE-P1EC0, or P1EC3-P1EC5 on page 9-378*
P0D11	Hybrid/EV Energy Storage - *DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE2, P0AE4, P0D0A, P0D11, P1EBC, P1EBE-P1EC0, or P1EC3-P1EC5 on page 9-378*
P0D1F	Plug-In Charging - *DTC P0D1F on page 9-563*
P0D21	Plug-In Charging - *DTC P0D21-P0D23 on page 9-564*
P0D22	Plug-In Charging - *DTC P0D21-P0D23 on page 9-564*
P0D23	Plug-In Charging - *DTC P0D21-P0D23 on page 9-564*
P0D2B	Plug-In Charging - *DTC P0D2B or P0D2C on page 9-567*
P0D2C	Plug-In Charging - *DTC P0D2B or P0D2C on page 9-567*
P0D39	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P0D3A	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P0D3B	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P0D3E	Plug-In Charging - *DTC P0D3E or P0D3F on page 9-572*
P0D3F	Plug-In Charging - *DTC P0D3E or P0D3F on page 9-572*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
P0D40	Plug-In Charging - *DTC P0D40, P1EDA, P1EDD, or P1F03 on page 9-575*
P0D43	Plug-In Charging - *DTC P0D43-P0D45 on page 9-576*
P0D44	Plug-In Charging - *DTC P0D43-P0D45 on page 9-576*
P0D45	Plug-In Charging - *DTC P0D43-P0D45 on page 9-576*
P0D49	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P0D4A	Plug-In Charging - *DTC P1EEF or P0D4A on page 9-592*
P0D4E	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P0D4F	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P0D53	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P0D54	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P0D57	Plug-In Charging - *DTC P0D57-P0D59 on page 9-578*
P0D58	Plug-In Charging - *DTC P0D57-P0D59 on page 9-578*
P0D59	Plug-In Charging - *DTC P0D57-P0D59 on page 9-578*
P0D5B	Plug-In Charging - *DTC P0D5B, P0D5C, P1ECE, or P1EFD on page 9-581*
P0D5C	Plug-In Charging - *DTC P0D5B, P0D5C, P1ECE, or P1EFD on page 9-581*
P0D5E	Plug-In Charging - *DTC P0D5E on page 9-583*
P0D69–P0D7F	HVAC – Automatic - *DTC P0D69-P0D7F on page 10-117*
P0DAA	Hybrid/EV Energy Storage - *DTC P0AA6, P0DAA, P1AE6, or P1F0E on page 9-392*
P148A	Hybrid/EV Battery Heating and Cooling - *DTC P148A-P148C on page 9-233*
P148B	Hybrid/EV Battery Heating and Cooling - *DTC P148A-P148C on page 9-233*
P148C	Hybrid/EV Battery Heating and Cooling - *DTC P148A-P148C on page 9-233*
P150D	Hybrid/EV Controls - *DTC P150D or P150E on page 9-108*
P150E	Hybrid/EV Controls - *DTC P150D or P150E on page 9-108*
P151C	HVAC - Automatic - *DTC P151C or P2516-P2518 on page 10-123*
P151E	Bumpers and Fascias - *DTC P059F or P151E on page 3-49*
P155A	Cruise Control - *Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C on page 9-45*
P155B	Cruise Control - *Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C on page 9-45*
P155C	Cruise Control - *Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C on page 9-45*
P15B9	Wiring Systems and Power Management - *DTC P15B9 or P15BA on page 11-844*
P15BA	Wiring Systems and Power Management - *DTC P15B9 or P15BA on page 11-844*
P15F1	Hybrid/EV Controls - *DTC P15F1 on page 9-110*
P15FB	Hybrid/EV Controls - *DTC P15FB on page 9-111*
P15FC	Hybrid/EV Controls - *DTC P15FC on page 9-112*
P162B	Immobilizer - *DTC P162B on page 12-22*
P162C	Cruise Control - *Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C on page 9-45*
P1631	Immobilizer - *DTC P1631 on page 12-23*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
P1649	Immobilizer - *DTC P1649 on page 12-24*
P16B7	Data Communications - *DTC P16B7 on page 11-39*
P16B8	Data Communications - *DTC P16B8-P16BA on page 11-41*
P16B9	Data Communications - *DTC P16B8-P16BA on page 11-41*
P16BA	Data Communications - *DTC P16B8-P16BA on page 11-41*
P16C1	Data Communications - *DTC P16C1-P16C5 on page 11-42*
P16C2	Data Communications - *DTC P16C1-P16C5 on page 11-42*
P16C3	Data Communications - *DTC P16C1-P16C5 on page 11-42*
P16C4	Data Communications - *DTC P16C1-P16C5 on page 11-42*
P16C5	Data Communications - *DTC P16C1-P16C5 on page 11-42*
P16C6	Data Communications - *DTC P16C6 on page 11-43*
P16F2	Hybrid/EV Controls - *DTC P16F2 on page 9-113*
P16F3	Hybrid/EV Controls - *DTC P16F3 on page 9-115*
P16F3	Hybrid/EV Controls - ECM - *DTC P0601-P0604, P0606, P062F, P0630, P16F3, or P262B (ECM) on page 9-67*
P16F4	Hybrid/EV Controls - *DTC P16F4 on page 9-116*
P16F6	Hybrid/EV Controls - *DTC P16F6 on page 9-118*
P179A	Hybrid/EV Controls - *DTC P179A on page 9-119*
P181C	Hybrid/EV Controls - *DTC P181C-P181F, P183A-P183E, P184A, or P184B on page 9-120*
P181D	Hybrid/EV Controls - *DTC P181C-P181F, P183A-P183E, P184A, or P184B on page 9-120*
P181E	Hybrid/EV Controls - *DTC P181C-P181F, P183A-P183E, P184A, or P184B on page 9-120*
P181F	Hybrid/EV Controls - *DTC P181C-P181F, P183A-P183E, P184A, or P184B on page 9-120*
P1824	Automatic Transmission - 1ET35 - *DTC P1824, P182A-P182F, P1838, or P1839 on page 16-21*
P182A	Automatic Transmission - 1ET35 - *DTC P1824, P182A-P182F, P1838, or P1839 on page 16-21*
P182B	Automatic Transmission - 1ET35 - *DTC P1824, P182A-P182F, P1838, or P1839 on page 16-21*
P182C	Automatic Transmission - 1ET35 - *DTC P1824, P182A-P182F, P1838, or P1839 on page 16-21*
P182D	Automatic Transmission - 1ET35 - *DTC P1824, P182A-P182F, P1838, or P1839 on page 16-21*
P182E	Automatic Transmission - 1ET35 - *DTC P1824, P182A-P182F, P1838, or P1839 on page 16-21*
P182F	Automatic Transmission - 1ET35 - *DTC P1824, P182A-P182F, P1838, or P1839 on page 16-21*
P1838	Automatic Transmission - 1ET35 - *DTC P1824, P182A-P182F, P1838, or P1839 on page 16-21*
P1839	Automatic Transmission - 1ET35 - *DTC P1824, P182A-P182F, P1838, or P1839 on page 16-21*
P183A	Hybrid/EV Controls - *DTC P181C-P181F, P183A-P183E, P184A, or P184B on page 9-120*
P183B	Hybrid/EV Controls - *DTC P181C-P181F, P183A-P183E, P184A, or P184B on page 9-120*
P183C	Hybrid/EV Controls - *DTC P181C-P181F, P183A-P183E, P184A, or P184B on page 9-120*
P183D	Hybrid/EV Controls - *DTC P181C-P181F, P183A-P183E, P184A, or P184B on page 9-120*
P183E	Hybrid/EV Controls - *DTC P181C-P181F, P183A-P183E, P184A, or P184B on page 9-120*
P183F	Hybrid/EV Controls - *DTC P183F on page 9-123*
P184A	Hybrid/EV Controls - *DTC P181C-P181F, P183A-P183E, P184A, or P184B on page 9-120*
P184B	Hybrid/EV Controls - *DTC P181C-P181F, P183A-P183E, P184A, or P184B on page 9-120*
P1A01	Data Communications - *DTC P0A1F, P1A01, P1A05, or P1A06 on page 11-38*
P1A05	Data Communications - *DTC P0A1F, P1A01, P1A05, or P1A06 on page 11-38*
P1A06	Data Communications - *DTC P0A1F, P1A01, P1A05, or P1A06 on page 11-38*
P1A07	Hybrid/EV Energy Storage - *DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040 on page 9-416*
P1A0C	12 V Starting and Charging - *DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC on page 9-9*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
P1A0D	12 V Starting and Charging - *DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC on page 9-9*
P1A4F	Hybrid/EV Controls - *DTC P1A4F, P1A50, P1A51, P1ADC, or P1EB6 on page 9-124*
P1A50	Hybrid/EV Controls - *DTC P1A4F, P1A50, P1A51, P1ADC, or P1EB6 on page 9-124*
P1A51	Hybrid/EV Controls - *DTC P1A4F, P1A50, P1A51, P1ADC, or P1EB6 on page 9-124*
P1A56	Hybrid/EV Controls - *DTC P1A56 on page 9-125*
P1A5E	Wiring Systems and Power Management - *DTC P1A5E or P1A5F on page 11-846*
P1A5F	Wiring Systems and Power Management - *DTC P1A5E or P1A5F on page 11-846*
P1A60	Wiring Systems and Power Management - *DTC P1A60 on page 11-848*
P1ADC	Hybrid/EV Controls - *DTC P1A4F, P1A50, P1A51, P1ADC, or P1EB6 on page 9-124*
P1ADE	Hybrid/EV Controls - *DTC P1ADE or P1ADF on page 9-126*
P1ADF	Hybrid/EV Controls - *DTC P1ADE or P1ADF on page 9-126*
P1AE6	Hybrid/EV Energy Storage - *DTC P0AA6, P0DAA, P1AE6, or P1F0E on page 9-392*
P1AE8	Hybrid/EV Controls - *DTC P1AE8 or P1AE9 on page 9-127*
P1AE9	Hybrid/EV Controls - *DTC P1AE8 or P1AE9 on page 9-127*
P1AEC	Hybrid/EV Controls - *DTC P1AEC or P1AEE on page 9-128*
P1AEE	Hybrid/EV Controls - *DTC P1AEC or P1AEE on page 9-128*
P1AF0	Hybrid/EV Controls - *DTC P1AF0 on page 9-130*
P1AF4	Hybrid/EV Controls - *DTC P1AF4 or P1AF5 on page 9-131*
P1AF5	Hybrid/EV Controls - *DTC P1AF4 or P1AF5 on page 9-131*
P1B03	Hybrid/EV Controls - *DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03 on page 9-78*
P1B0B	Hybrid/EV Controls - *DTC P1B0B or P1B0C on page 9-132*
P1B0C	Hybrid/EV Controls - *DTC P1B0B or P1B0C on page 9-132*
P1B0D	Hybrid/EV Controls - *DTC P1B0D on page 9-133*
P1B0F	Hybrid/EV Controls - *DTC P1B0F on page 9-134*
P1B0F	Hybrid/EV Controls - *DTC P0C17 or P1B0F on page 9-100*
P1B12	Antilock Brake System - *DTC P1B12 on page 5-69*
P1B15	Hybrid/EV Controls - *DTC P1B15 on page 9-137*
P1B16–P1B2D	Hybrid/EV Energy Storage - *DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B on page 9-408*
P1B41	Hybrid/EV Controls - *DTC P1B41 on page 9-138*
P1B45–P1BFE	Hybrid/EV Energy Storage - *DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B on page 9-408*
P1BFF	Hybrid/EV Controls - *DTC P1BFF, P1E23-P1E25, or P1EB8 on page 9-139*
P1E00	Hybrid/EV Controls - *DTC P1E00 on page 9-140*
P1E01	Hybrid/EV Energy Storage - *DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B on page 9-408*
P1E02	Hybrid/EV Energy Storage - *DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B on page 9-408*
P1E03	Hybrid/EV Energy Storage - *DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B on page 9-408*
P1E04	Hybrid/EV Energy Storage - *DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B on page 9-408*
P1E05	Hybrid/EV Energy Storage - *DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B on page 9-408*
P1E06	Hybrid/EV Energy Storage - *DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B on page 9-408*
P1E0A	Hybrid/EV Controls - *DTC P1E0A on page 9-141*
P1E19	Hybrid/EV Controls - *DTC P1E19 or P1E1A on page 9-142*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
P1E1A	Hybrid/EV Controls - *DTC P1E19 or P1E1A on page 9-142*
P1E1B	Hybrid/EV Controls - *DTC P1E1B-P1E1F on page 9-143*
P1E1C	Hybrid/EV Controls - *DTC P1E1B-P1E1F on page 9-143*
P1E1D	Hybrid/EV Controls - *DTC P1E1B-P1E1F on page 9-143*
P1E1E	Hybrid/EV Controls - *DTC P1E1B-P1E1F on page 9-143*
P1E1F	Hybrid/EV Controls - *DTC P1E1B-P1E1F on page 9-143*
P1E20	Hybrid/EV Controls - *DTC P1E20-P1E22 on page 9-145*
P1E21	Hybrid/EV Controls - *DTC P1E20-P1E22 on page 9-145*
P1E22	Hybrid/EV Controls - *DTC P1E20-P1E22 on page 9-145*
P1E23	Hybrid/EV Controls - *DTC P1BFF, P1E23-P1E25, or P1EB8 on page 9-139*
P1E24	Hybrid/EV Controls - *DTC P1BFF, P1E23-P1E25, or P1EB8 on page 9-139*
P1E25	Hybrid/EV Controls - *DTC P1BFF, P1E23-P1E25, or P1EB8 on page 9-139*
P1E27	Hybrid/EV Controls - *DTC P1E27 or P1E28 on page 9-146*
P1E28	Hybrid/EV Controls - *DTC P1E27 or P1E28 on page 9-146*
P1E29	Hybrid/EV Controls - *DTC P1E29 on page 9-147*
P1E2A	Hybrid/EV Controls - *DTC P1E2A-P1E2F on page 9-148*
P1E2B	Hybrid/EV Controls - *DTC P1E2A-P1E2F on page 9-148*
P1E2C	Hybrid/EV Controls - *DTC P1E2A-P1E2F on page 9-148*
P1E2D	Hybrid/EV Controls - *DTC P1E2A-P1E2F on page 9-148*
P1E2E	Hybrid/EV Controls - *DTC P1E2A-P1E2F on page 9-148*
P1E2F	Hybrid/EV Controls - *DTC P1E2A-P1E2F on page 9-148*
P1E34	Hybrid/EV Controls - *DTC P1E34-P1E36 on page 9-149*
P1E35	Hybrid/EV Controls - *DTC P1E34-P1E36 on page 9-149*
P1E36	Hybrid/EV Controls - *DTC P1E34-P1E36 on page 9-149*
P1E37	Hybrid/EV Controls - *DTC P1E37 on page 9-150*
P1E38	Hybrid/EV Controls - *DTC P1E38 on page 9-151*
P1E39	Hybrid/EV Controls - *DTC P1E39 on page 9-152*
P1E3A	Hybrid/EV Controls - *DTC P1E3A on page 9-154*
P1E4A	Hybrid/EV Controls - *DTC P1E4A on page 9-155*
P1E4C–P1E8B	Hybrid/EV Energy Storage - *DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B on page 9-408*
P1E8C	Hybrid/EV Battery Heating and Cooling - *DTC P0C47, P0C4A, P1E8C, or P1E8D on page 9-215*
P1E8D	Hybrid/EV Battery Heating and Cooling - *DTC P0C47, P0C4A, P1E8C, or P1E8D on page 9-215*
P1E8E	Data Communications - *DTC P1E8E-P1E91 or P1F06 on page 11-45*
P1E8F	Data Communications - *DTC P1E8E-P1E91 or P1F06 on page 11-45*
P1E90	Data Communications - *DTC P1E8E-P1E91 or P1F06 on page 11-45*
P1E91	Data Communications - *DTC P1E8E-P1E91 or P1F06 on page 11-45*
P1E92	Hybrid/EV Energy Storage - *DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041 on page 9-418*
P1E93	Hybrid/EV Energy Storage - *DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040 on page 9-416*
P1E94	Data Communications - *DTC P1E94-P1E97 or P1F07 on page 11-46*
P1E95	Data Communications - *DTC P1E94-P1E97 or P1F07 on page 11-46*
P1E96	Data Communications - *DTC P1E94-P1E97 or P1F07 on page 11-46*
P1E97	Data Communications - *DTC P1E94-P1E97 or P1F07 on page 11-46*
P1E98	Hybrid/EV Energy Storage - *DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041 on page 9-418*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
P1E99	Hybrid/EV Energy Storage - *DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040 on page 9-416*
P1E9A	Data Communications - *DTC P1E9A-P1E9D or P1F08 on page 11-47*
P1E9B	Data Communications - *DTC P1E9A-P1E9D or P1F08 on page 11-47*
P1E9C	Data Communications - *DTC P1E9A-P1E9D or P1F08 on page 11-47*
P1E9D	Data Communications - *DTC P1E9A-P1E9D or P1F08 on page 11-47*
P1E9E	Hybrid/EV Energy Storage - *DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041 on page 9-418*
P1E9F	Hybrid/EV Energy Storage - *DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040 on page 9-416*
P1EA0	Data Communications - *DTC P1EA0-P1EA3 or P1F09 on page 11-48*
P1EA1	Data Communications - *DTC P1EA0-P1EA3 or P1F09 on page 11-48*
P1EA2	Data Communications - *DTC P1EA0-P1EA3 or P1F09 on page 11-48*
P1EA3	Data Communications - *DTC P1EA0-P1EA3 or P1F09 on page 11-48*
P1EA4	Hybrid/EV Energy Storage - *DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041 on page 9-418*
P1EA5	Hybrid/EV Energy Storage - *DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040 on page 9-416*
P1EAB	Hybrid/EV Energy Storage - *DTC P1EAB or P1EAC on page 9-420*
P1EAC	Hybrid/EV Energy Storage - *DTC P1EAB or P1EAC on page 9-420*
P1EB1	Data Communications - *DTC P1EB1 on page 11-49*
P1EB2	Data Communications - *DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B on page 11-50*
P1EB3	Data Communications - *DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B on page 11-50*
P1EB4	Data Communications - *DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B on page 11-50*
P1EB5	Data Communications - *DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B on page 11-50*
P1EB6	Hybrid/EV Controls - *DTC P1A4F, P1A50, P1A51, P1ADC, or P1EB6 on page 9-124*
P1EB8	Hybrid/EV Controls - *DTC P1BFF, P1E23-P1E25, or P1EB8 on page 9-139*
P1EB9	Data Communications - *DTC P1EB9 on page 11-52*
P1EBE	Hybrid/EV Energy Storage - *DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE2, P0AE4, P0D0A, P0D11, P1EBC, P1EBE-P1EC0, or P1EC3-P1EC5 on page 9-378*
P1EBF	Hybrid/EV Energy Storage - *DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE2, P0AE4, P0D0A, P0D11, P1EBC, P1EBE-P1EC0, or P1EC3-P1EC5 on page 9-378*
P1EC0	Hybrid/EV Energy Storage - *DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE2, P0AE4, P0D0A, P0D11, P1EBC, P1EBE-P1EC0, or P1EC3-P1EC5 on page 9-378*
P1EBC	Hybrid/EV Energy Storage - *DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE2, P0AE4, P0D0A, P0D11, P1EBC, P1EBE-P1EC0, or P1EC3-P1EC5 on page 9-378*
P1EC1	Data Communications - *DTC P1EC1 or P1EC2 on page 11-55*
P1EC2	Data Communications - *DTC P1EC1 or P1EC2 on page 11-55*
P1EC3	Hybrid/EV Energy Storage - *DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE2, P0AE4, P0D0A, P0D11, P1EBC, P1EBE-P1EC0, or P1EC3-P1EC5 on page 9-378*
P1EC4	Hybrid/EV Energy Storage - *DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE2, P0AE4, P0D0A, P0D11, P1EBC, P1EBE-P1EC0, or P1EC3-P1EC5 on page 9-378*
P1EC5	Hybrid/EV Energy Storage - *DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE2, P0AE4, P0D0A, P0D11, P1EBC, P1EBE-P1EC0, or P1EC3-P1EC5 on page 9-378*
P1EC6	Hybrid/EV Battery Heating and Cooling - *DTC P1EC6 on page 9-235*
P1EC7	Hybrid/EV Battery Heating and Cooling - *DTC P0CE2, P0CE3, P1EC7, P1EC8, or P1F56 on page 9-222*
P1EC8	Hybrid/EV Battery Heating and Cooling - *DTC P0CE2, P0CE3, P1EC7, P1EC8, or P1F56 on page 9-222*
P1EC9	HVAC - Automatic - *DTC P1ECA or P1EC9 on page 10-126*
P1ECA	HVAC - Automatic - *DTC P1ECA or P1EC9 on page 10-126*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
P1ECB	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1ECC	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1ECD	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1ECE	Plug-In Charging - *DTC P0D5B, P0D5C, P1ECE, or P1EFD on page 9-581*
P1ED0	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1ED1	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1ED2	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1ED6	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1ED7	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1ED8	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1ED9	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1EDA	Plug-In Charging - *DTC P0D40, P1EDA, P1EDD, or P1F03 on page 9-575*
P1EDB	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1EDC	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1EDD	Plug-In Charging - *DTC P0D40, P1EDA, P1EDD, or P1F03 on page 9-575*
P1EDE	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1EDF	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1EE0	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1EE1	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1EE3	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1EE5	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1EE6	Plug-In Charging - *DTC P1EE6 on page 9-589*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
P1EE7	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1EE8	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1EE9	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1EEA	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1EEB	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1EEC	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1EED	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1EEF	Plug-In Charging - *DTC P1EEF or P0D4A on page 9-592*
P1EF0	Plug-In Charging - *DTC P1EF0 or P1EF1 on page 9-594*
P1EF1	Plug-In Charging - *DTC P1EF0 or P1EF1 on page 9-594*
P1EF3	Plug-In Charging - *DTC P1EF3-P1EF5 on page 9-596*
P1EF4	Plug-In Charging - *DTC P1EF3-P1EF5 on page 9-596*
P1EF5	Plug-In Charging - *DTC P1EF3-P1EF5 on page 9-596*
P1EF6	Wiring Systems and Power Management - *DTC P1EF6 or P1EF7 on page 11-850*
P1EF7	Wiring Systems and Power Management - *DTC P1EF6 or P1EF7 on page 11-850*
P1EF8	Data Communications - *DTC P1EF8 on page 11-57*
P1EFA	Plug-In Charging - *DTC P1EFA or P1EFB on page 9-597*
P1EFB	Plug-In Charging - *DTC P1EFA or P1EFB on page 9-597*
P1EFC	12 V Starting and Charging - *DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC on page 9-9*
P1EFD	Plug-In Charging - *DTC P0D5B, P0D5C, P1ECE, or P1EFD on page 9-581*
P1EFE	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1EFF	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1F01	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1F02	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1F03	Plug-In Charging - *DTC P0D40, P1EDA, P1EDD, or P1F03 on page 9-575*
P1F06	Data Communications - *DTC P1E8E-P1E91 or P1F06 on page 11-45*
P1F07	Data Communications - *DTC P1E94-P1E97 or P1F07 on page 11-46*
P1F08	Data Communications - *DTC P1E9A-P1E9D or P1F08 on page 11-47*
P1F09	Data Communications - *DTC P1EA0-P1EA3 or P1F09 on page 11-48*
P1F0A	HVAC - Automatic - *DTC P1F0A-P1F0D on page 10-128*
P1F0B	HVAC - Automatic - *DTC P1F0A-P1F0D on page 10-128*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
P1F0C	HVAC - Automatic - *DTC P1F0A-P1F0D on page 10-128*
P1F0D	HVAC - Automatic - *DTC P1F0A-P1F0D on page 10-128*
P1F0E	Hybrid/EV Energy Storage - *DTC P0AA6, P0DAA, P1AE6, or P1F0E on page 9-392*
P1F14	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1F15	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1F16	Plug-In Charging - *DTC P0D39-P0D3B, P0D49, P0D4E, P0D4F, P0D53, P0D54, P1ECB-P1ECD, P1ED0-P1ED2, P1ED6-P1ED9, P1EDB, P1EDC, P1EDE-P1EE1, P1EE3, P1EE5, P1EE7-P1EED, P1EFE-P1F02, or P1F14-P1F16 on page 9-570*
P1F17	Hybrid/EV Energy Storage - *DTC P1F17 on page 9-427*
P1F44	Hybrid/EV Battery Heating and Cooling - *DTC P0CE9, P0CEA, P1F44, or P1F45 on page 9-228*
P1F45	Hybrid/EV Battery Heating and Cooling - *DTC P0CE9, P0CEA, P1F44, or P1F45 on page 9-228*
P1F56	Hybrid/EV Battery Heating and Cooling - *DTC P0CE2, P0CE3, P1EC7, P1EC8, or P1F56 on page 9-222*
P1F58	Hybrid/EV Battery Heating and Cooling - *DTC P0CE5-P0CE7 and P1F58 on page 9-225*
P1F59	Hybrid/EV Controls - *DTC P1F59, P1F5A, or P1F5B on page 9-156*
P1F5A	Hybrid/EV Controls - *DTC P1F59, P1F5A, or P1F5B on page 9-156*
P1F5B	Hybrid/EV Controls - *DTC P1F59, P1F5A, or P1F5B on page 9-156*
P1F5D	Hybrid/EV Controls - *DTC P1F5D or P1F5E on page 9-159*
P1F5E	Hybrid/EV Controls - *DTC P1F5D or P1F5E on page 9-159*
P1FA6	Data Communications - *DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B on page 11-50*
P1FA7	Data Communications - *DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B on page 11-50*
P1FA8	Data Communications - *DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B on page 11-50*
P1FA9	Data Communications - *DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B on page 11-50*
P1FAA	Data Communications - *DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B on page 11-50*
P1FAB	Data Communications - *DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B on page 11-50*
P1FAC	Data Communications - *DTC P1FAC, P1FB1, P1FB7, P1FBD, or P1FCF on page 11-59*
P1FAD	Data Communications - *DTC P1FAD, P1FB3, P1FB9, P1FBF, or P1FD1 on page 11-60*
P1FAE	Data Communications - *DTC P1FAE, P1FB4, P1FBA, P1FC0, or P1FD2 on page 11-61*
P1FAF	Data Communications - *DTC P1FAF, P1FB5, P1FBB, P1FC1, or P1FD3 on page 11-62*
P1FB0	Data Communications - *DTC P1FB0, P1FB6, P1FBC, P1FC2, or P1FD4 on page 11-63*
P1FB1	Data Communications - *DTC P1FAC, P1FB1, P1FB7, P1FBD, or P1FCF on page 11-59*
P1FB2	Data Communications - *DTC P1FB2, P1FB8, P1FBE, P1FD0, or P1FF3 on page 11-64*
P1FB3	Data Communications - *DTC P1FAD, P1FB3, P1FB9, P1FBF, or P1FD1 on page 11-60*
P1FB4	Data Communications - *DTC P1FAE, P1FB4, P1FBA, P1FC0, or P1FD2 on page 11-61*
P1FB5	Data Communications - *DTC P1FAF, P1FB5, P1FBB, P1FC1, or P1FD3 on page 11-62*
P1FB6	Data Communications - *DTC P1FB0, P1FB6, P1FBC, P1FC2, or P1FD4 on page 11-63*
P1FB7	Data Communications - *DTC P1FAC, P1FB1, P1FB7, P1FBD, or P1FCF on page 11-59*
P1FB8	Data Communications - *DTC P1FB2, P1FB8, P1FBE, P1FD0, or P1FF3 on page 11-64*
P1FB9	Data Communications - *DTC P1FAD, P1FB3, P1FB9, P1FBF, or P1FD1 on page 11-60*
P1FBA	Data Communications - *DTC P1FAE, P1FB4, P1FBA, P1FC0, or P1FD2 on page 11-61*
P1FBB	Data Communications - *DTC P1FAF, P1FB5, P1FBB, P1FC1, or P1FD3 on page 11-62*
P1FBC	Data Communications - *DTC P1FB0, P1FB6, P1FBC, P1FC2, or P1FD4 on page 11-63*
P1FBD	Data Communications - *DTC P1FAC, P1FB1, P1FB7, P1FBD, or P1FCF on page 11-59*
P1FBE	Data Communications - *DTC P1FB2, P1FB8, P1FBE, P1FD0, or P1FF3 on page 11-64*
P1FBF	Data Communications - *DTC P1FAD, P1FB3, P1FB9, P1FBF, or P1FD1 on page 11-60*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
P1FC0	Data Communications - *DTC P1FAE, P1FB4, P1FBA, P1FC0, or P1FD2 on page 11-61*
P1FC1	Data Communications - *DTC P1FAF, P1FB5, P1FBB, P1FC1, or P1FD3 on page 11-62*
P1FC2	Data Communications - *DTC P1FB0, P1FB6, P1FBC, P1FC2, or P1FD4 on page 11-63*
P1FC3	Hybrid/EV Energy Storage - *DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040 on page 9-416*
P1FC4	Hybrid/EV Energy Storage - *DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040 on page 9-416*
P1FC5	Hybrid/EV Energy Storage - *DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040 on page 9-416*
P1FC6	Hybrid/EV Energy Storage - *DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040 on page 9-416*
P1FC7	Hybrid/EV Energy Storage - *DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040 on page 9-416*
P1FC8	Hybrid/EV Energy Storage - *DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040 on page 9-416*
P1FC9	Hybrid/EV Energy Storage - *DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041 on page 9-418*
P1FCA	Hybrid/EV Energy Storage - *DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041 on page 9-418*
P1FCB	Hybrid/EV Energy Storage - *DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041 on page 9-418*
P1FCC	Hybrid/EV Energy Storage - *DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041 on page 9-418*
P1FCD	Hybrid/EV Energy Storage - *DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041 on page 9-418*
P1FCE	Hybrid/EV Energy Storage - *DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041 on page 9-418*
P1FCF	Data Communications - *DTC P1FAC, P1FB1, P1FB7, P1FBD, or P1FCF on page 11-59*
P1FD0	Data Communications - *DTC P1FB2, P1FB8, P1FBE, P1FD0, or P1FF3 on page 11-64*
P1FD1	Data Communications - *DTC P1FAD, P1FB3, P1FB9, P1FBF, or P1FD1 on page 11-60*
P1FD2	Data Communications - *DTC P1FAE, P1FB4, P1FBA, P1FC0, or P1FD2 on page 11-61*
P1FD3	Data Communications - *DTC P1FAF, P1FB5, P1FBB, P1FC1, or P1FD3 on page 11-62*
P1FD4	Data Communications - *DTC P1FB0, P1FB6, P1FBC, P1FC2, or P1FD4 on page 11-63*
P1FD5	Hybrid/EV Energy Storage - *DTC P1FD5-P1FF2 on page 9-424*
P1FD6	Hybrid/EV Energy Storage - *DTC P1FD5-P1FF2 on page 9-424*
P1FD7	Hybrid/EV Energy Storage - *DTC P1FD5-P1FF2 on page 9-424*
P1FD8	Hybrid/EV Energy Storage - *DTC P1FD5-P1FF2 on page 9-424*
P1FD9	Hybrid/EV Energy Storage - *DTC P1FD5-P1FF2 on page 9-424*
P1FE0	Hybrid/EV Energy Storage - *DTC P1FD5-P1FF2 on page 9-424*
P1FE1	Hybrid/EV Energy Storage - *DTC P1FD5-P1FF2 on page 9-424*
P1FE2	Hybrid/EV Energy Storage - *DTC P1FD5-P1FF2 on page 9-424*
P1FE3	Hybrid/EV Energy Storage - *DTC P1FD5-P1FF2 on page 9-424*
P1FE4	Hybrid/EV Energy Storage - *DTC P1FD5-P1FF2 on page 9-424*
P1FE5	Hybrid/EV Energy Storage - *DTC P1FD5-P1FF2 on page 9-424*
P1FE6	Hybrid/EV Energy Storage - *DTC P1FD5-P1FF2 on page 9-424*
P1FE7	Hybrid/EV Energy Storage - *DTC P1FD5-P1FF2 on page 9-424*
P1FE8	Hybrid/EV Energy Storage - *DTC P1FD5-P1FF2 on page 9-424*
P1FE9	Hybrid/EV Energy Storage - *DTC P1FD5-P1FF2 on page 9-424*
P1FF0	Hybrid/EV Energy Storage - *DTC P1FD5-P1FF2 on page 9-424*
P1FF1	Hybrid/EV Energy Storage - *DTC P1FD5-P1FF2 on page 9-424*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
P1FF2	Hybrid/EV Energy Storage - *DTC P1FD5-P1FF2 on page 9-424*
P1FF3	Data Communications - *DTC P1FB2, P1FB8, P1FBE, P1FD0, or P1FF3 on page 11-64*
P1FF4	Hybrid/EV Energy Storage - *DTC P1FF4 on page 9-429*
P1FFB	Hybrid/EV Battery Heating and Cooling - *DTC P1FFB-P1FFE on page 9-238*
P1FFC	Hybrid/EV Battery Heating and Cooling - *DTC P1FFB-P1FFE on page 9-238*
P1FFD	Hybrid/EV Battery Heating and Cooling - *DTC P1FFB-P1FFE on page 9-238*
P1FFE	Hybrid/EV Battery Heating and Cooling - *DTC P1FFB-P1FFE on page 9-238*
P1FFF	Hybrid/EV Battery Heating and Cooling - *DTC P1FFF on page 9-240*
P1FFF	Plug-In Charging - *DTC P1FFF on page 9-599*
P2122	Hybrid/EV Controls - *DTC P2122, P2123, P2127, P2128, or P2138 on page 9-161*
P2123	Hybrid/EV Controls - *DTC P2122, P2123, P2127, P2128, or P2138 on page 9-161*
P2127	Hybrid/EV Controls - *DTC P2122, P2123, P2127, P2128, or P2138 on page 9-161*
P2128	Hybrid/EV Controls - *DTC P2122, P2123, P2127, P2128, or P2138 on page 9-161*
P2138	Hybrid/EV Controls - *DTC P2122, P2123, P2127, P2128, or P2138 on page 9-161*
P215B	Automatic Transmission - 1ET35 - *DTC P215B on page 16-24*
P2516	HVAC - Automatic - *DTC P151C or P2516-P2518 on page 10-123*
P2517	HVAC - Automatic - *DTC P151C or P2516-P2518 on page 10-123*
P2518	HVAC - Automatic - *DTC P151C or P2516-P2518 on page 10-123*
P2534	Wiring Systems and Power Management - *DTC P2534 or P2535 on page 11-852*
P2535	Wiring Systems and Power Management - *DTC P2534 or P2535 on page 11-852*
P2537	Hybrid/EV Controls - *DTC P2537 (Hybrid Powertrain Control Module 1) on page 9-165*
P2537	Wiring Systems and Power Management - *DTC P2537 (Hybrid/EV Powertrain Control Module 2) on page 11-854*
P257D	Bolted Exterior Body Panels and Closures - *DTC P257D-P257F on page 3-7*
P257E	Bolted Exterior Body Panels and Closures - *DTC P257D-P257F on page 3-7*
P257F	Bolted Exterior Body Panels and Closures - *DTC P257D-P257F on page 3-7*
P262B	Hybrid/EV Controls - Hybrid Powertrain Control Module 1 - *DTC P0601-P0606, P060A, P062F, or P262B (Hybrid Powertrain Control Module 1) on page 9-65*
P262B	Data Communications - *DTC P0601-P0606, P060A, P062F, or P262B on page 11-33*
P262B	Hybrid/EV Controls - ECM - *DTC P0601-P0604, P0606, P062F, P0630, P16F3, or P262B (ECM) on page 9-67*
P263A	Hybrid/EV Controls - *DTC P0650, P263A, or P263B on page 9-72*
P263B	Hybrid/EV Controls - *DTC P0650, P263A, or P263B on page 9-72*
P2797	Hybrid/EV Controls - *DTC P2797 on page 9-167*
P3002	Plug-In Charging - *DTC P3002, P3003, P301F, or P3020 on page 9-600*
P3003	Plug-In Charging - *DTC P3002, P3003, P301F, or P3020 on page 9-600*
P3005	Plug-In Charging - *DTC P3005, P3006, P3021, or P3022 on page 9-604*
P3006	Plug-In Charging - *DTC P3005, P3006, P3021, or P3022 on page 9-604*
P3008	Plug-In Charging - *DTC P3008, P3009, or P3023 on page 9-608*
P3009	Plug-In Charging - *DTC P3008, P3009, or P3023 on page 9-608*
P300B	Plug-In Charging - *DTC P300B on page 9-611*
P300C	Plug-In Charging - *DTC P300C, P300D, or P300F on page 9-614*
P300D	Plug-In Charging - *DTC P300C, P300D, or P300F on page 9-614*
P300F	Plug-In Charging - *DTC P300C, P300D, or P300F on page 9-614*
P3010	Plug-In Charging - *DTC P3010, P3013, or P3014 on page 9-616*
P3013	Plug-In Charging - *DTC P3010, P3013, or P3014 on page 9-616*
P3014	Plug-In Charging - *DTC P3010, P3013, or P3014 on page 9-616*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
P3015	Plug-In Charging - *DTC P3015, P3018, P301C, or P301D on page 9-618*
P3018	Plug-In Charging - *DTC P3015, P3018, P301C, or P301D on page 9-618*
P301C	Plug-In Charging - *DTC P3015, P3018, P301C, or P301D on page 9-618*
P301D	Plug-In Charging - *DTC P3015, P3018, P301C, or P301D on page 9-618*
P301E	Plug-In Charging - *DTC P301E on page 9-622*
P301F	Plug-In Charging - *DTC P3002, P3003, P301F, or P3020 on page 9-600*
P3020	Plug-In Charging - *DTC P3002, P3003, P301F, or P3020 on page 9-600*
P3021	Plug-In Charging - *DTC P3005, P3006, P3021, or P3022 on page 9-604*
P3022	Plug-In Charging - *DTC P3005, P3006, P3021, or P3022 on page 9-604*
P3023	Plug-In Charging - *DTC P3008, P3009, or P3023 on page 9-608*
P302B	Plug-In Charging - *DTC P302B-P302D on page 9-625*
P302C	Plug-In Charging - *DTC P302B-P302D on page 9-625*
P302D	Plug-In Charging - *DTC P302B-P302D on page 9-625*
P302F	Plug-In Charging - *DTC P302F on page 9-627*
P3030	Data Communications - *DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B on page 11-50*
P3031	Data Communications - *DTC P3031-P3034 or P3037 on page 11-65*
P3032	Data Communications - *DTC P3031-P3034 or P3037 on page 11-65*
P3033	Data Communications - *DTC P3031-P3034 or P3037 on page 11-65*
P3034	Data Communications - *DTC P3031-P3034 or P3037 on page 11-65*
P3035	Hybrid/EV Energy Storage - *DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040 on page 9-416*
P3036	Hybrid/EV Energy Storage - *DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041 on page 9-418*
P3037	Data Communications - *DTC P3031-P3034 or P3037 on page 11-65*
P303B	Data Communications - *DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B on page 11-50*
P303C	Data Communications - *DTC P303C-P303F or P3042 on page 11-66*
P303D	Data Communications - *DTC P303C-P303F or P3042 on page 11-66*
P303E	Data Communications - *DTC P303C-P303F or P3042 on page 11-66*
P303F	Data Communications - *DTC P303C-P303F or P3042 on page 11-66*
P3040	Hybrid/EV Energy Storage - *DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040 on page 9-416*
P3041	Hybrid/EV Energy Storage - *DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041 on page 9-418*
P3042	Data Communications - *DTC P303C-P303F or P3042 on page 11-66*
U0020	Data Communications - *DTC U0020 on page 11-67*
U0073	Data Communications - *DTC U0073 or U2100 on page 11-68*
U0074	Data Communications - *DTC U0074 on page 11-69*
U0077	Data Communications - *DTC U0077 on page 11-74*
U0078	Data Communications - *DTC U0078 on page 11-80*
U007A	Data Communications - *DTC U007A on page 11-75*
U0100-U02FF	Data Communications - *DTC U0100-U02FF on page 11-81*
U0300-U0336	Data Communications - *DTC U0300-U0336 on page 11-86*
U0400-U05FF	Data Communications - *DTC U0400-U05FF on page 11-87*
U1500-U15FF	Data Communications - *DTC U1500-U15FF on page 11-88*
U179A	Data Communications - *DTC U179A on page 11-91*
U1803	Data Communications - *DTC U1803 on page 11-94*
U1806	Data Communications - *DTC U1806 on page 11-97*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
U1807	Data Communications - *DTC U1807 on page 11-98*
U180A	Data Communications - *DTC U180A on page 11-99*
U180B	Data Communications - *DTC U180B on page 11-100*
U180C	Data Communications - *DTC U180C on page 11-101*
U180D	Data Communications - *DTC U180D on page 11-102*
U1814	Data Communications - *DTC U1814 on page 11-103*
U1817	Data Communications - *DTC U1817 on page 11-105*
U1818	Data Communications - *DTC U1818 on page 11-108*
U182D	Data Communications - *DTC U182D on page 11-111*
U182E	Data Communications - *DTC U182E on page 11-114*
U1833	Data Communications - *DTC U1833 on page 11-117*
U1838	Data Communications - *DTC U1838 on page 11-120*
U1839	Data Communications - *DTC U1839 on page 11-123*
U183C	Data Communications - *DTC U183C on page 11-126*
U183E	Data Communications - *DTC U183E on page 11-129*
U1845	Data Communications - *DTC U1845 or U1846 on page 11-132*
U1846	Data Communications - *DTC U1845 or U1846 on page 11-132*
U184A	Data Communications - *DTC U184A on page 11-134*
U184B	Data Communications - *DTC U184B on page 11-137*
U184C	Data Communications - *DTC U184C on page 11-140*
U184D	Data Communications - *DTC U184D on page 11-143*
U184E	Data Communications - *DTC U184E on page 11-146*
U1858	Data Communications - *DTC U1858 on page 11-149*
U185A	Data Communications - *DTC U185A on page 11-152*
U185B	Data Communications - *DTC U185B on page 11-157*
U185C	Data Communications - *DTC U185C on page 11-161*
U1860	Data Communications - *DTC U1860 on page 11-164*
U1861	Data Communications - *DTC U1861 on page 11-167*
U186A	Data Communications - *DTC U186A on page 11-170*
U186B	Data Communications - *DTC U186B on page 11-173*
U1876	Data Communications - *DTC U1876 on page 11-176*
U1885	Data Communications - *DTC U1885 on page 11-179*
U18A4	Data Communications - *DTC U18A4 on page 11-183*
U18B9-U18BF	Data Communications - *DTC U18B9-U18BF on page 11-186*
U2099	Data Communications - *DTC U2099 on page 11-187*
U2100	Data Communications - *DTC U0073 or U2100 on page 11-68*
U2401	Data Communications - *DTC U2401 on page 11-189*
U2602	Data Communications - *DTC U2602 on page 11-192*
U2603-U2606	Data Communications - *DTC U2603-U2606 or U2617-U2622 on page 11-196*
U2608	Data Communications - *DTC U2608 on page 11-198*
U2609	Data Communications - *DTC U2609 on page 11-201*
U2611	Data Communications - *DTC U2611 on page 11-204*
U2612	Data Communications - *DTC U2612 on page 11-206*
U2613	Data Communications - *DTC U2613 on page 11-209*
U2615	Data Communications - *DTC U2615 on page 11-212*

Diagnostic Trouble Code (DTC) List - Vehicle (cont'd)

DTC	Diagnostic Procedure
U2617-U2622	Data Communications - *DTC U2603-U2606 or U2617-U2622 on page 11-196*
U2623	Data Communications - *DTC U2623 or U2624 on page 11-215*
U2624	Data Communications - *DTC U2623 or U2624 on page 11-215*

Symptom Byte List

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
(00–0F) General Electrical Failures This category includes standard wiring failure modes (for example, shorts and opens), direct current (DC) quantities related by Ohm's Law and quantities related to amplitude, frequency or rate of change, and wave shape.		
00	—	This sub type is used for failures that cannot be assigned to a specific sub type. No additional information is available.
01	Short to Battery	This sub type is used for failures where the Electronic Control Unit measures vehicle system (battery positive) potential for greater than a specified time period or when some other value is expected.
02	Short to Ground	This sub type is used for failures where the Electronic Control Unit measures ground (battery negative) potential for greater than a specified time period or when some other value is expected.
03	Low Voltage	This sub type is used for failures where the Electronic Control Unit measures a voltage below a specified range but not necessarily a short to ground.
04	Open	This sub type is used for failures where the Electronic Control Unit determines an open circuit via lack of bias voltage, low current flow, no change in state of an input in response to an output, etc.
05	High Voltage/Open	This sub type is used for failures where the condition detected by the Electronic Control Unit is the same for either indicated failure mode.
06	Low Voltage/Open	This sub type is used for failures where the condition detected by the Electronic Control Unit is the same for either indicated failure mode.
07	High Voltage	This sub type is used for failures where the Electronic Control Unit measures a voltage above a specified range but not necessarily a short to battery.
08	Performance – Signal Invalid	This sub type is used for failures where the value of the signal is not plausible given the operating conditions.
09	Too Fast Transitions	This sub type is used for failures where the signal transitions more quickly than is reasonably allowed.
0A	Too Slow Transitions	This sub type is used for failures where the signal transitions more slowly than is reasonably allowed.
0B	High Current	This sub type is used for failures where the Electronic Control Unit measures current flow above a specified range.
0C	Low Current	This sub type is used for failures where the Electronic Control Unit measures current flow below a specified range.
0D	High Resistance	This sub type is used for failures where the Electronic Control Unit infers a circuit resistance above a specified range.
0E	Low Resistance	This sub type is used for failures where the Electronic Control Unit infers a circuit resistance below a specified range.
0F	Signal Erratic	This sub type is used for failures where the signal is momentarily implausible (not long enough for Signal Invalid) or discontinuous.
(10–1F) Additional General Electrical Failures This category includes the overflow from category 0.		
10	—	Currently not used.

Symptom Byte List (cont'd)

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
11	High Input	This sub type is used for failures where some circuit quantity is above a specified range.
12	Low Input	This sub type is used for failures where some circuit quantity is below a specified range.
13	Low Voltage/High Temperature	This sub type is used for failures where a temperature sensor with a negative temperature coefficient detects a voltage below a specified range.
14	High Voltage/Low Temperature	This sub type is used for failures where a temperature sensor with a negative temperature coefficient detects a voltage above a specified range.
15	Performance – Signal Rising Time Failure	This sub type is used for failures where the signal rise time is outside a specified range.
16	Performance – Signal Falling Time Failure	This sub type is used for failures where the signal fall time is outside a specified range.
17	Performance – Signal Shape/ Waveform Failure	This sub type is used for failures where the shape of the signal (plot of the amplitude with respect to time) is not correct (for example, improper circuit impedance.)
18	Low Signal Amplitude	This sub type is used for failures where the Electronic Control Unit measures a signal voltage below a specified range but not necessarily a short to ground (for example, gain too low).
19	High Signal Amplitude	This sub type is used for failures where the Electronic Control Unit measures a signal voltage above a specified range but not necessarily a short to battery (for example, gain too high).
1A	Performance – Bias Level Out of Range	This sub type is used for failures where the Electronic Control Unit applies a bias voltage to a circuit upon which is superimposed a signal voltage (for example, Oxygen Sensor Circuit.)
1B	Signal Cross Coupled	This sub type is used for failures where the Electronic Control Unit detects a circuit shorted to another circuit when both circuits are controlled by the Electronic Control Unit.
1C	—	Currently not used.
1D	—	Currently not used.
1E	—	Currently not used.
1F	Erratic	This sub type is used for failures where the Electronic Control Unit momentarily detects one of the conditions defined above but not long enough to set a specific sub type.
(20–2F) FM / PWM Failures This category includes faults related to Frequency Modulated (FM) and Pulse Width Modulated (PWM) inputs and outputs of the Electronic Control Unit and faults where position is determined by counts.		
20	—	Currently not used.
21	Incorrect Period	This sub type is used for failures where the Electronic Control Unit measures an incorrect duration for one cycle of the output.
22	Too Short Low-Time	This sub type is used for failures where the Electronic Control Unit detects the low pulse is too narrow with respect to time.
23	Too Long Low-Time	This sub type is used for failures where the Electronic Control Unit detects the low pulse is too wide with respect to time.
24	Too Short High-Time	This sub type is used for failures where the Electronic Control Unit detects the high pulse is too narrow with respect to time.
25	Too Long High-Time	This sub type is used for failures where the Electronic Control Unit detects the high pulse is too wide with respect to time.
26	Low Frequency	This sub type is used for failures where the Electronic Control Unit detects too few cycles in a given time period.
27	High Frequency	This sub type is used for failures where the Electronic Control Unit detects too many cycles in a given time period.
28	Incorrect Frequency	This sub type is used for failures where the Electronic Control Unit measures an incorrect number of cycles in a given time period.

Symptom Byte List (cont'd)

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
29	Too Few Pulses	This sub type is used for failures where the Electronic Control Unit measures too few pulses (for example, position is calibrated in counts from one extreme to the other).
2A	Too Many Pulses	This sub type is used for failures where the Electronic Control Unit measures too many pulses (for example, position is calibrated in counts from one extreme to the other).
2B	Missing Reference	This sub type is used for failures where the Electronic Control Unit does not detect a reference for a signal circuit or a group of signal circuits.
2C	—	Currently not used.
2D	—	Currently not used.
2E	—	Currently not used.
2F	—	Currently not used.
(30–3F) Electronic Control Unit Internal Failures This category includes faults related to memory, software, and internal electrical circuitry; requiring component replacement.		
30	—	Currently not used.
31	Internal Checksum Error	This sub type is used by the Electronic Control Unit to indicate an incorrect checksum calculation where memory type is not specified.
32	General Memory Malfunction	This sub type is used by the Electronic Control Unit to indicate a memory failure where memory type is not specified.
33	Special Memory Malfunction	This sub type is used by the Electronic Control Unit to indicate a memory failure where the specific memory type is not defined in this category.
34	RAM Malfunction	This sub type is used by the Electronic Control Unit to indicate a Random Access Memory (RAM) failure.
35	ROM Malfunction	This sub type is used by the Electronic Control Unit to indicate a Read Only Memory (ROM) failure.
36	EEPROM Performance/Malfunction	This sub type is used by the Electronic Control Unit to indicate an Electrically Erasable Programmable Read Only Memory (EEPROM) failure.
37	Software Malfunction	This sub type is used by the Electronic Control Unit to indicate a failure in the execution of operational software
38	Supervision Software Malfunction	This sub type is used by the Electronic Control Unit to indicate a loop time error in the execution of the operational software.
39	Internal Malfunction	This sub type is used by the Electronic Control Unit to indicate the detection of an internal circuit failure.
3A	Incorrect Component Installed	This sub type is used by the Electronic Control Unit to indicate a mismatch between the hardware connected to the Electronic Control Unit and the hardware expected by the Electronic Control Unit.
3B	Self-Test Malfunction	This sub type is used by the Electronic Control Unit to indicate a sensor self-test failure launched by an Electronic Control Unit command.
3C	Internal Communication Malfunction	This sub type is used by the Electronic Control Unit to indicate loss of an internal communication line, for example, between microprocessors in a dual microprocessor configuration.
3D	—	Currently not used.
3E	—	Currently not used.
3F	—	Currently not used.
(40–4F) Electronic Control Unit Programming Failures This category includes faults related to operational software, calibrations, and options; remedied by programming the Electronic Control Unit.		
40	—	Currently not used.
41	Not Programmed	This sub type is used to indicate that only boot software is present in the Electronic Control Unit.

Symptom Byte List (cont'd)

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
42	Calibration Not Programmed	This sub type is used to indicate that operational software is present but calibration data is not.
43	EEPROM Incorrect Programming	This sub type is used to indicate an EEPROM error that may be remedied by reprogramming the module.
44	Security Access Not Activated	This sub type is used to indicate that programming was attempted without unlocking the Electronic Control Unit.
45	Variant Not Programmed	This sub type is used to indicate the need to enter (program) the sub system option content.
46	Configuration Not Programmed	This sub type is used to indicate the need to enter (program) the vehicle option content.
47	VIN Not Programmed	This sub type is used to indicate the need to enter (program) the vehicle identification number (VIN).
48	Security Code Not Programmed	This sub type is used to indicate the need to enter (program) the theft / security code.
49	RAM Incorrect Programming	This sub type is used by the Electronic Control Unit to indicate a Random Access Memory (RAM) error remedied by reprogram-ming.
4A	Programming Checksum Error	This sub type is used by the Electronic Control Unit to indicate an incorrect checksum calculation where memory type is not specified.
4B	Calibration Not Learned	This sub type is used by the Electronic Control Unit to indicate that a password, operational range, etc. for a sensor or actuator must be learned by the Electronic Control Unit.
4C	DTC Memory Full	This sub type is used by the Electronic Control Unit to indicate that more DTCs have been detected than can be accommodated by the memory allocated for DTC storage.
4D	Stack Overflow	This subtype is used by the Electronic Control Unit to indicate that more memory has been used in a stack than is allocated to a program.
4E	—	Currently not used.
4F	—	Currently not used.
(50–5F) Algorithm Based Failures This category includes faults based on comparing two or more input parameters for plausibility or comparing a single parameter to itself with respect to time.		
50	—	Currently not used.
51	—	Currently not used.
52	—	Currently not used.
53	Low Temperature	This sub type is used for failures where the Electronic Control Unit calculates a low temperature condition based upon the duration of certain operating parameters.
54	High Temperature	This sub type is used for failures where the Electronic Control Unit calculates a high temperature condition based upon the duration of certain operating parameters.
55	Too Few Transitions	This sub type is used for failures where the Electronic Control Unit monitors a parameter over time within specified limits and detects fewer than the expected number of transitions.
56	Too Many Transitions	This sub type is used for failures where the Electronic Control Unit monitors a parameter over time within specified limits and detects more than the expected number of transitions.
57	—	Currently not used.
58	Performance	This sub type is used for failures where the Electronic Control Unit does not see the expected change to a parameter or group of parameters in response to a particular event.
59	Protection Time-Out	This sub type is used for failures where the Electronic Control Unit detects a function is active for greater than a specified time period.

Symptom Byte List (cont'd)

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
5A	Not Plausible	This sub type is used for failures where the Electronic Control Unit compares two or more input parameters for plausibility.
5B	—	Currently not used.
5C	—	Currently not used.
5D	—	Currently not used.
5E	—	Currently not used.
5F	—	Currently not used.
(60–6F) Mechanical Failures This category includes faults detected by inappropriate motion in response to an Electronic Control Unit controlled output.		
60	—	Currently not used.
61	Stuck	This sub type is used for failures where the Electronic Control Unit does not detect any motion in response to energizing a motor, solenoid, relay, etc.
62	Stuck Open	This sub type is used for failures where the Electronic Control Unit does not detect any motion upon commanding the operation of a motor, solenoid, relay, etc., to close some piece of equipment.
63	Stuck Closed	This sub type is used for failures where the Electronic Control Unit does not detect any motion upon commanding the operation of a motor, solenoid, relay, etc., to open some piece of equipment.
64	Slip Detected	This sub type is used for failures where the Electronic Control Unit detects excessive duration to command a motor, solenoid, relay, etc., to move a piece of equipment to a desired position.
65	Emergency Position Not Achievable	This sub type is used for failures where the Electronic Control Unit is unable to command a motor, solenoid, relay, etc., to move a piece of equipment to the emergency position.
66	Incorrect Mounting	This sub type is used for failures where the server detects incorrectly mounted components, for example, acceleration sensor showing a position error of 90°.
67	Incorrect Assembly	This sub type is used for failures where the control module has detected that the component has been incorrectly installed (for example, hydraulic pipes crossed over, circuits cross wired) or polarity errors.
68	—	Currently not used.
69	—	Currently not used.
6A	—	Currently not used.
6B	—	Currently not used.
6C	—	Currently not used.
6D	—	Currently not used.
6E	—	Currently not used.
6F	—	Currently not used.
(70–7F) Bus Signal / Message Failures This category includes faults related to bus hardware and signal integrity. This category is also used when the physical input for a signal is located in one Electronic Control Unit and another Electronic Control Unit diagnoses the circuit.		
70	—	Currently not used.
71	Invalid Data	This sub type is used by the Electronic Control Unit to indicate a signal was received with the corresponding validity bit equal to Invalid or post processing of the signal determines it is invalid.
72	Message Counter Incorrect	This sub type is used by the Electronic Control Unit to indicate a signal was received without the corresponding rolling count value being properly updated.
73	Parity Error	This sub type is used by the Electronic Control Unit to indicate a message was processed with an incorrect parity calculation.

Symptom Byte List (cont'd)

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
74	Bus Signal Checksum Error	This sub type is used by the Electronic Control Unit to indicate a message was processed with an incorrect protection (checksum) calculation.
75	Serial Data Link High Input	This sub type is used for failures where some circuit quantity, reported via serial data, is above a specified range.
76	Serial Data Link Low Input	This sub type is used for failures where some circuit quantity, reported via serial data, is below a specified range.
77	—	Currently not used.
78	—	Currently not used.
79	—	Currently not used.
7A	—	Currently not used.
7B	—	Currently not used.
7C	—	Currently not used.
7D	—	Currently not used.
7E	—	Currently not used.
7F	Bus Signal Erratic	This sub type is used for failures where the signal, reported via serial data, is momentarily implausible or discontinuous.
(80–FF) Reserved Unique System Specific – See specific diagnostic procedures for symptom byte information if these symptom bytes are used.		

Symptoms - Vehicle

Body Repair

- *Symptoms - Active Grille Air Shutter on page 3-51*
- *Symptoms - Bolted Exterior Body Panels and Closures on page 3-9*

Body Systems

- *Symptoms - Fixed and Moveable Windows on page 4-10*
- *Symptoms - Horns on page 4-58*
- *Symptoms - Lighting on page 4-141*
- *Symptoms - Mirrors on page 4-204*
- *Symptoms - Vehicle Access on page 4-237*
- *Symptoms - Wiper/Washer Systems on page 4-304*

Brakes

- *Symptoms - Antilock Brake System on page 5-70*
- *Symptoms - Hydraulic Brakes on page 5-136*
- *Symptoms - Park Brake on page 5-244*

Driveline/Axle

Symptoms - Wheel Drive Shafts on page 7-3

Driver Information and Entertainment

- *Symptoms - Cellular Communication on page 8-28*
- *Symptoms - Entertainment on page 8-28*
- *Symptoms - Displays and Gauges on page 8-84*
- *Symptoms - Secondary and Configurable Customer Controls on page 8-109*

Propulsion

- *Symptoms - Engine Electrical on page 9-14*
- *Symptoms - Cruise Control on page 9-43*
- *Symptoms - Hybrid Controls on page 9-167*

General Information

- *Symptoms - Squeaks and Rattles on page 1-34*
- *Symptoms - Vibration Diagnosis and Correction on page 1-50*

HVAC

Symptoms - HVAC Systems - Automatic on page 10-129

Power and Signal Distribution

- *Symptoms - Data Communications on page 11-218*
- *Symptoms - Power Outlets on page 11-246*

Safety and Security

- *Symptoms - Immobilizer on page 12-24*
- *Symptoms - Object Detection on page 12-41*
- *Symptoms - Remote Functions on page 12-66*
- *Symptoms - Seat Belts on page 12-86*
- *Symptoms - SIR on page 12-147*
- *Symptoms - Theft Deterrent on page 12-187*

Seats

Symptoms - Seat Heating and Cooling on page 13-29

Steering

- *Symptoms - Power Steering System on page 14-9*
- *Symptoms - Steering Wheel and Column on page 14-24*

Suspension

- *Symptoms - Suspension General Diagnosis on page 15-28*
- *Symptoms - Tire Pressure Monitoring on page 15-41*

Transmission

- *Symptoms - Automatic Transmission on page 16-25*
- *Symptoms - Automatic Transmission Shift Lock Control on page 16-102*

Inspection/Maintenance System Check

There are no Inspection/Maintenance System Check testing requirements for this vehicle.

Diagnostic Repair Verification

Note: After a repair has been made, some DTCs require the ignition to be turned OFF then back ON before the scan tool function will clear the DTC.

1. Vehicle OFF.
2. Install any components or connectors that have been removed or replaced during diagnosis.
3. Perform any adjustment, programming or setup procedures that are required when a component or module is removed or replaced.
4. Vehicle in Service Mode.
5. Clear the DTCs.
6. Vehicle OFF for 60 seconds.
7. If the repair was related to a DTC, duplicate the Conditions for Running the DTC and use the Freeze Frame/Failure Records, if applicable, in order to verify the DTC does not reset. If the DTC resets or another DTC is present, refer to the *Diagnostic Trouble Code (DTC) List - Vehicle on page 6-92* and perform the appropriate diagnostic procedure.

   Or

   If the repair was symptom related, duplicate the conditions under which the customer concern occurred to verify the repair. If the customer concern reoccurs or another symptom is present, return to *Symptoms - Vehicle on page 6-122* and perform the appropriate symptom diagnostic.

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Section 7

Driveline/Axle

Wheel Drive Shafts 7-3
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Wheel Drive Shafts

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Wheel Drive Shaft Nut		
First pass	50 N•m	37 lb ft
Final Pass	plus 60 degrees	

Diagnostic Information and Procedures

Symptoms - Wheel Drive Shafts

Note: Complete the following steps prior to beginning the wheel drive shaft diagnosis.

1. Perform the *Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer) on page 1-37* or *Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope) on page 1-39* in order to effectively diagnose the concern.
2. Review the system operation in order to become familiar with the system function. Refer to *Wheel Drive Shafts Description and Operation on page 7-16*.

Visual/Physical Inspection

- Inspect for aftermarket equipment and modifications which could affect the operation of the wheel drive shafts or other rotating components.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Thoroughly inspect the entire wheel drive shaft for visible damage, leaking joint seals, and missing seal clamps.
- Inspect the wheel drive shaft seals for cuts, tears, or other damage which may allow the loss of lubricant and the entry of contaminants.

Symptom List

After performing the Visual/Physical Inspection and no visual signs of damage or other interference impairing the wheel drive shaft function is apparent, it may be necessary to remove the wheel drive shaft from the vehicle and manipulate the joints manually. Any binding or otherwise impeded movement of the joints may indicate damage which could contribute to the concern. Refer to the following:

- *Click Noise In Turns on page 7-3*
- *Clunk When Accelerating from Coast on page 7-3*
- *Clunk Noise When Accelerating During Turns on page 7-4*

Click Noise In Turns

A click noise occurring during turns may be caused by a worn or damaged wheel drive shaft outer joint. This may be more apparent while simultaneously turning and accelerating. This click is caused by wear and/or damage to the constant velocity joint bearings and/or races. Commonly, this damage or wear is caused by the loss of lubricating grease from the constant velocity joint and the entry of foreign material or contaminants.

Carefully inspect the wheel drive shaft seals for cuts, tears or other damage which may allow the lubricating grease to escape. The loss of this grease will cause damage to the wheel drive shaft constant velocity joint in a very short period of time.

If inspection reveals no visual evidence of wear or damage, it may be necessary to remove the wheel drive shaft from the vehicle and manipulate the outer joint manually. Any binding or impeded movement of the joint may indicate damage which could contribute to the concern.

Clunk When Accelerating from Coast

A clunk noise occurring when accelerating from coast or a standing start may be caused by a worn or damaged wheel drive shaft inner joint. The common cause of wheel drive shaft inner joint damage is the loss of lubricating grease and/or the presence of foreign material and contaminates in the joint. This usually occurs as a result of a torn or damaged inner joint seal.

Carefully inspect the wheel drive shaft seal for cuts, tears or other damage that may allow the loss of the lubricating grease and/or the entry of contaminates.

If inspection reveals no visual evidence of wear or damage, it may be necessary to remove the wheel drive shaft from the vehicle and manipulate the inner joint manually. Do not allow the joint to separate from the wheel drive shaft bar. Any binding or impeded movement of the joint may indicate damage which could contribute to the concern.

Clunk Noise When Accelerating During Turns

A clunk noise that occurs while accelerating during turns may be caused by wear and/or damage to the inboard and the outboard joints in combination. The loss of lubricant and/or the presence of contaminates can cause damage to the internal components of the joints.

Carefully inspect the joint seals for cuts, tears or other damage. Joint seals that are damaged may allow lubricant leakage and the entry of contaminants.

If inspection reveals no visual evidence of wear or damage, it may be necessary to remove the wheel drive shaft from the vehicle and manipulate the joints manually. Do not allow the joints to separate from the wheel drive shaft bar. Any binding or impeded movement of the joints may indicate damage which could contribute to the concern.

Shudder or Vibration During Acceleration

In order to diagnose a shudder or vibration during acceleration, refer to *Symptoms - Vibration Diagnosis and Correction on page 1-50*.

Repair Instructions

Front Wheel Drive Shaft Replacement - Left Side

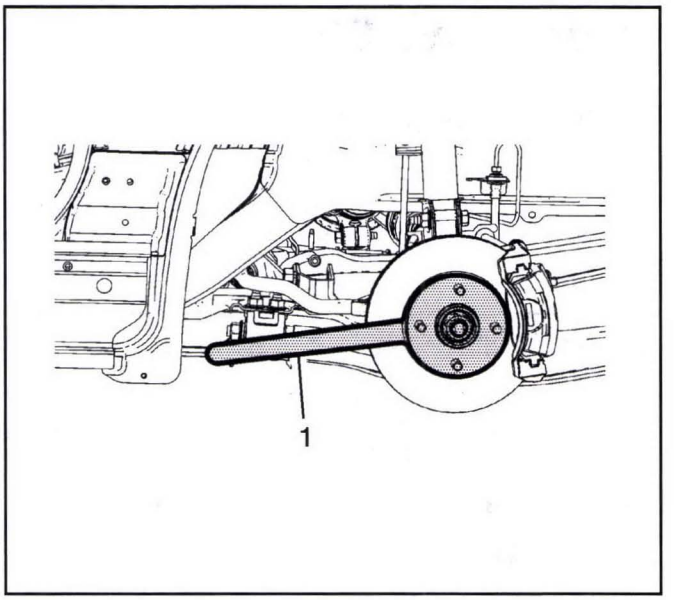
Special Tools

- *DT-50186* Wheel Hub Holding Tool
- *DT-50188* Hub Spindle Remover
- *CH-313* Hammer
- *CH-6003* Remover

Removal Procedure

Caution: Refer to *Vehicle Lifting and Jacking Caution on page 0-10*.

1. Raise and support the vehicle. Refer to *Vehicle Lifting and Jacking Caution on page 0-10*.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
3. Remove the front compartment splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.
4. Remove the wheel speed sensor from the knuckle and set it aside. Refer to *Front Wheel Speed Sensor Replacement on page 5-84*.



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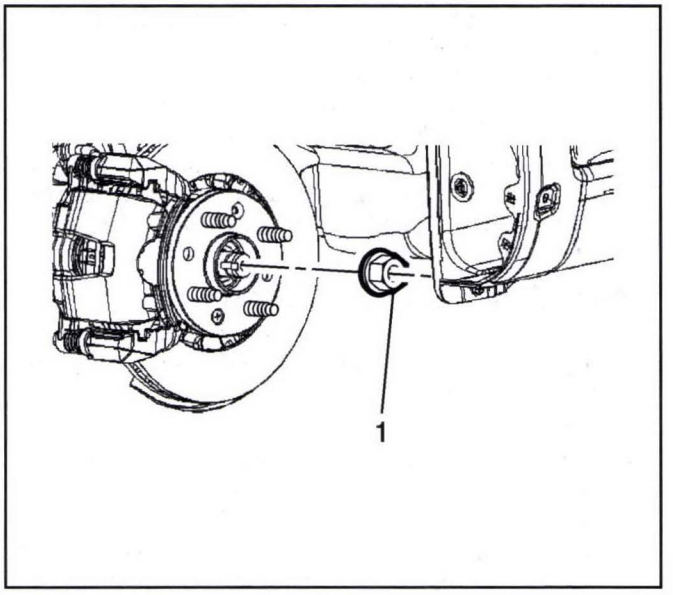
5. Install the *DT-50186* tool (1) to the wheel hub with the wheel nuts.



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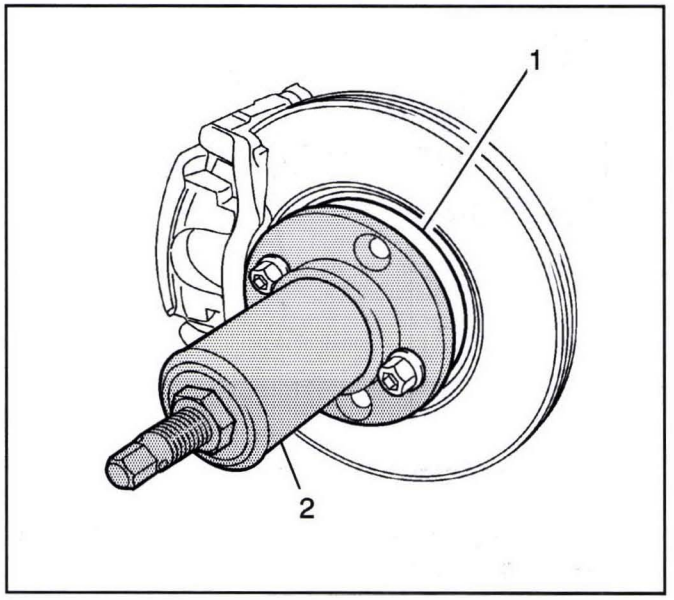
Caution: Make sure that the wheel drive shaft nut is fully un-staked to avoid damage to the wheel drive shaft threads during the removal of the wheel drive shaft nut. Failure to follow these instructions could result in wheel, nut, and/or stud damage.

Note: Use a suitable tool to release the crimping on the wheel drive shaft retaining nut.

Note: The wheel drive shaft retaining nut (1) must be discarded after removal.

6. Remove the wheel drive shaft nut (1) from the wheel drive shaft and discard.
7. Remove the *DT-50186* wheel hub holding tool from the wheel hub.
8. Disconnect the outer tie rod assembly from the steering knuckle. Refer to *Steering Linkage Outer Tie Rod Replacement on page 14-14*.

9. Separate the control arm ball joint from the steering knuckle. Refer to *Lower Control Arm Replacement on page 15-9*.



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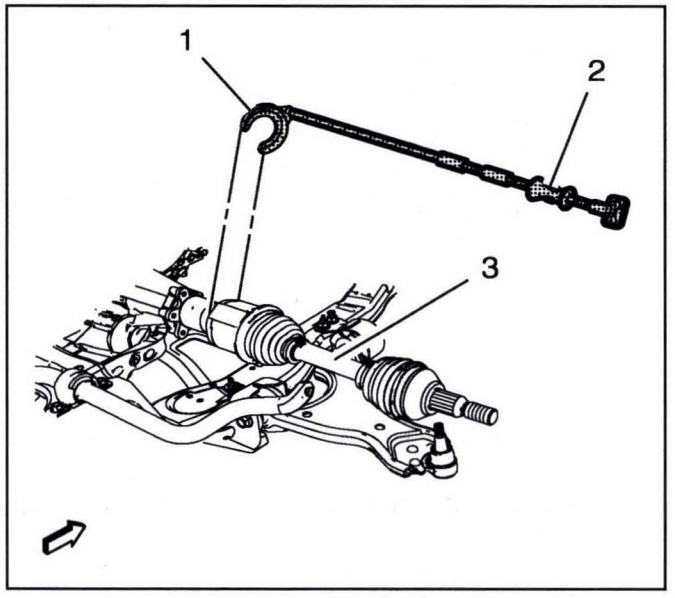
10. Using the *DT-50188* hub spindle remover (2), separate the wheel drive shaft from the steering knuckle (1).



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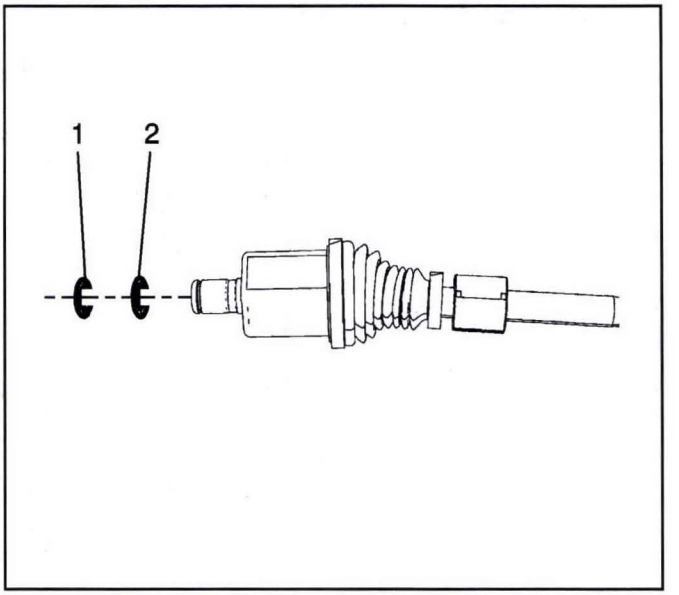
11. Using the *CH-313* hammer (2) with the *CH-6003* remover (1) remove the wheel drive shaft (3) from the vehicle.



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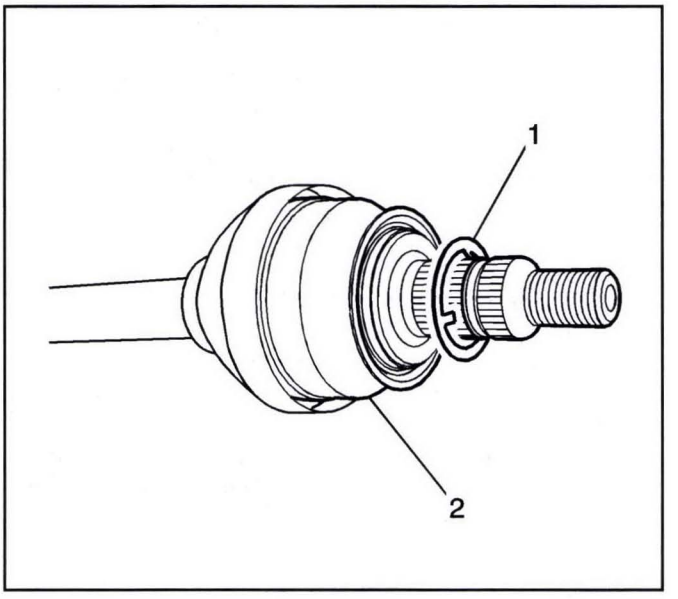
Note: If there is no snap ring or O-ring on the wheel drive shaft . Install a new snap ring and O-ring.

12. Remove and discard the snap ring (1) and O-ring (2) from the wheel drive shaft.



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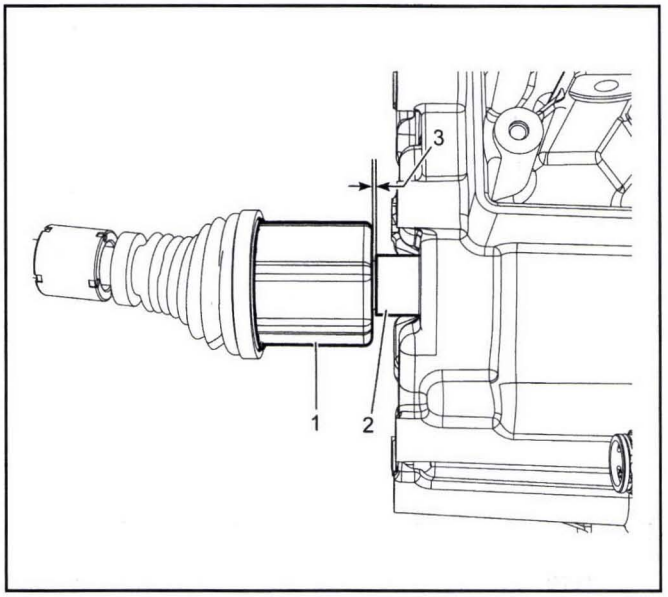
Note: If there is no washer on the wheel drive shaft , install a NEW washer.

13. Remove and discard the washer (1) from the wheel drive shaft (2). Do not re-use the washer , replace with NEW only.

Installation Procedure



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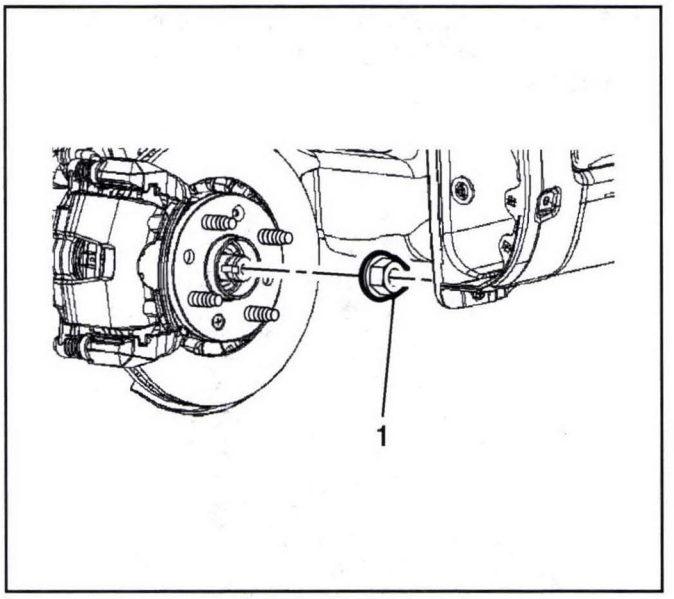
1. Install the inner tripod housing (1) until the wheel drive shaft splines are fully seated into the stub (2) extending from the transaxle.

   Note: Gap (3) between the inner tripod housing (1) and the stub (2) must be less than or equal to **3.7mm(0.148 in)** to prevent damage to the stub. In the following step, DO NOT pull on the wheel drive shaft. Pull only on the inner joint.
2. With the wheel drive shaft installed, grasp the inner tripot housing and pull the tripot outward to ensure that the wheel drive shaft is properly engaged. The wheel drive shaft will remain in place if properly installed.
3. Install the wheel drive shaft to the front wheel hub/ bearing.
4. Install the control arm ball joint to the steering knuckle. Refer to *Lower Control Arm Replacement on page 15-9*.
5. Install the outer tie rod assembly to the steering knuckle. Refer to *Steering Linkage Outer Tie Rod Replacement on page 14-14*.



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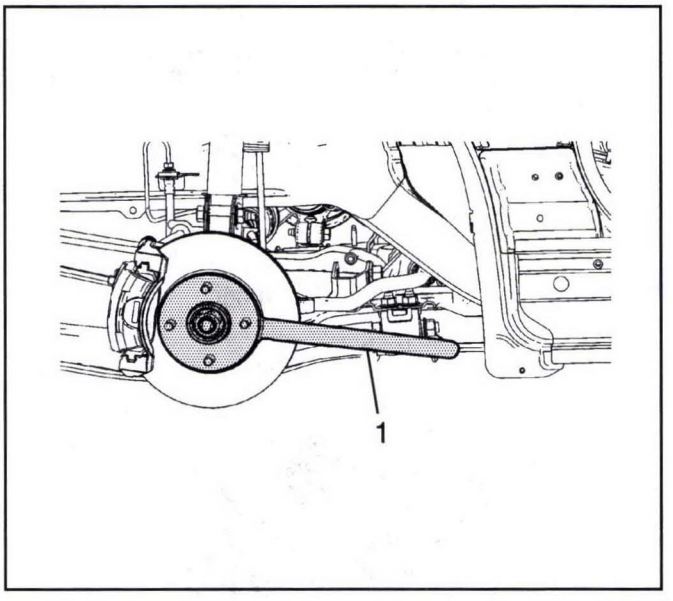
6. Hand tighten the NEW wheel drive shaft nut (1) on the wheel drive shaft.



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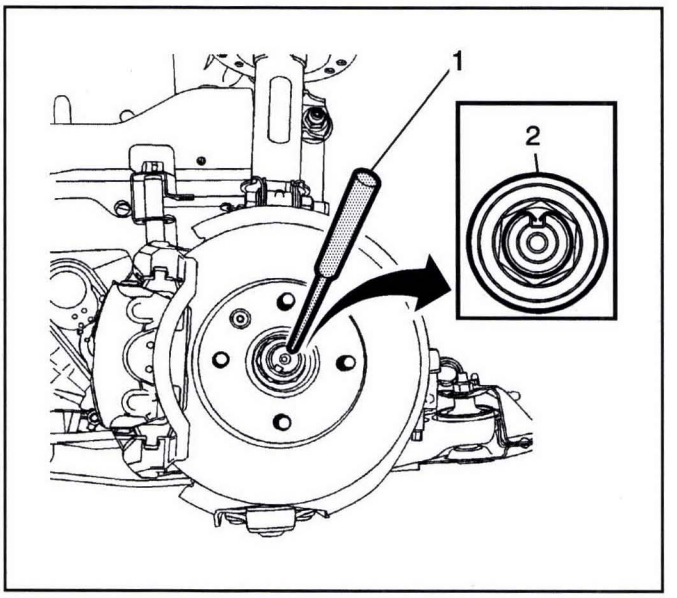
7. Install the *DT-50186* wheel hub holding tool (1) to the wheel hub with two wheel nuts.
8. Support the *DT-50186* wheel hub holding tool (1) outer end on a safety stand.

Caution: Refer to *Fastener Caution on page 0-8*.

9. Using a torque wrench and the appropriate size socket, install the wheel drive shaft nut and tighten to:
   - First Pass 50 N.m (37 lb ft)
   - Final Pass plus 60 degrees
10. Remove the *DT-50186* wheel hub holding tool (1) from the wheel hub.



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Note: Evenly split the center of the wheel drive shaft nut (2) and ensure that it is fully staked. Each side of the stake should be in contact and approximately 45 degrees to each side of the slot in the wheel drive shaft

11. Using a punch (1) a hammer , stake the wheel drive shaft nut stake the wheel drive shaft nut (2) into the slot on the wheel drive shaft.
12. Install the wheel speed sensor into the knuckle. Refer to *Front Wheel Speed Sensor Replacement on page 5-84*.
13. Install the front compartment splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.
14. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
15. Lower the vehicle.

Front Wheel Drive Shaft Replacement - Right Side

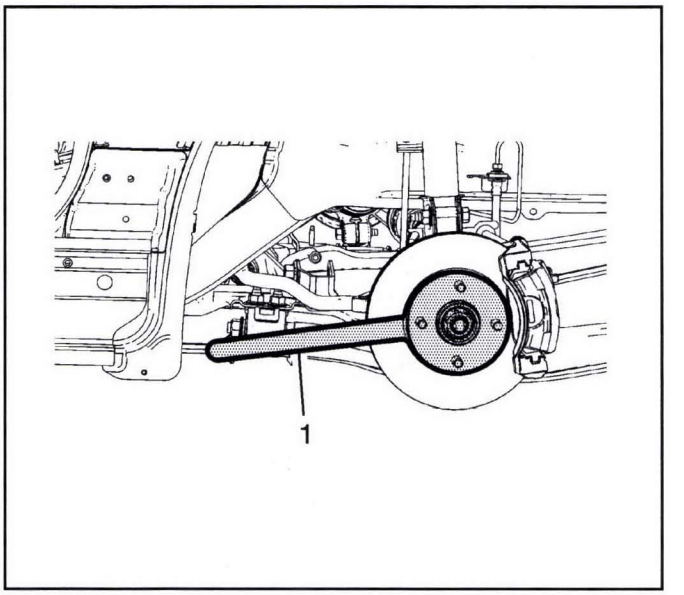
Special Tools

- *DT-50186* Wheel Hub Holding Tool
- *DT-50188* Hub Spindle Remover
- *CH-313* Hammer
- *CH-6003* Remover

Removal Procedure

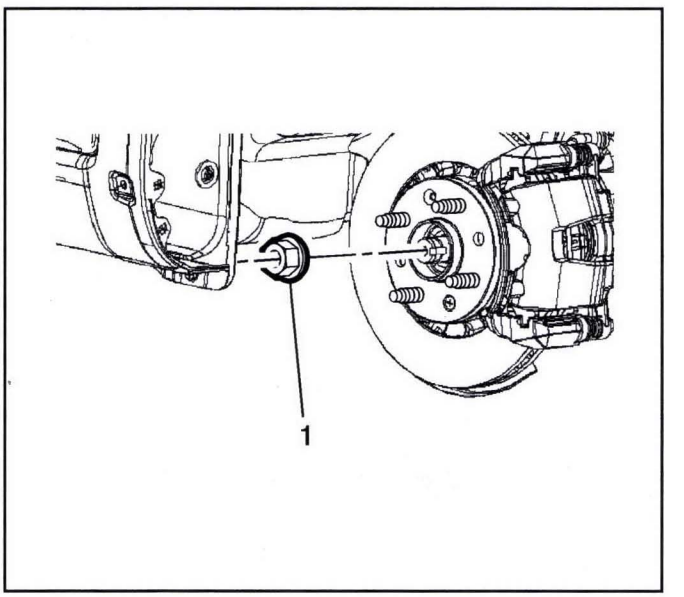
Caution: Refer to *Vehicle Lifting and Jacking Caution on page 0-10*.

1. Raise and support the vehicle. Refer to *Vehicle Lifting and Jacking Caution on page 0-10*.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
3. Remove the front compartment splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*
4. Remove the wheel speed sensor from the knuckle and set it aside. Refer to *Front Wheel Speed Sensor Replacement on page 5-84*.



2965515

5. Install the *DT-50186* tool (1) to the wheel hub with the wheel nuts.



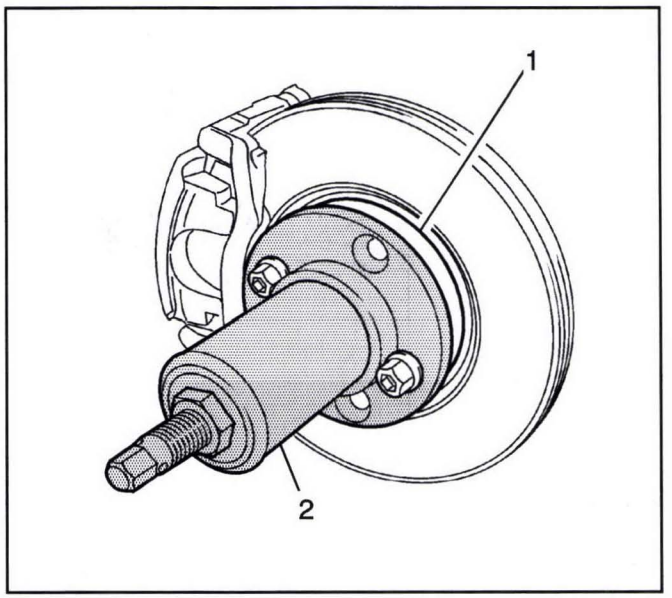
3327121

Caution: Make sure that the wheel drive shaft nut is fully un-staked to avoid damage to the wheel drive shaft threads during the removal of the wheel drive shaft nut. Failure to follow these instructions could result in wheel, nut, and/or stud damage.

Note: Use a suitable tool to release the crimping on the wheel drive shaft retaining nut.

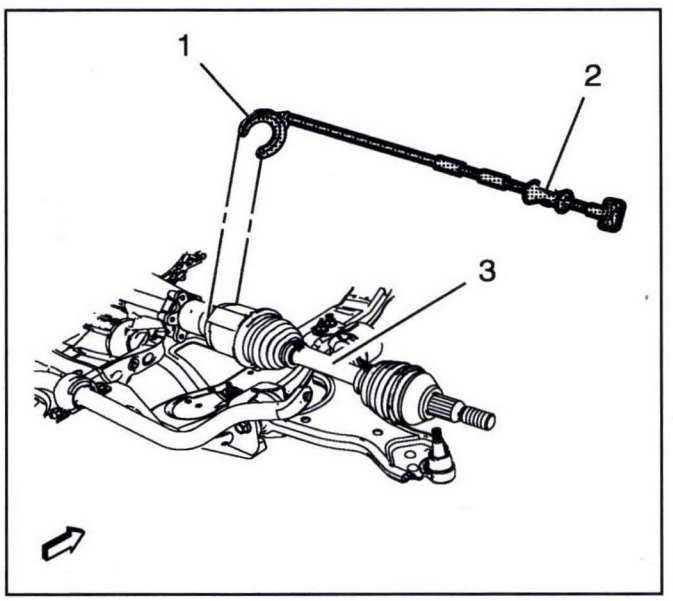
Note: The wheel drive shaft retaining nut (1) must be discarded after removal.

6. Remove the wheel drive shaft nut (1) from the wheel drive shaft and discard.
7. Remove the *DT-50186* tool from the wheel hub.
8. Disconnect the outer tie rod assembly from the steering knuckle. Refer to *Steering Linkage Outer Tie Rod Replacement on page 14-14*.
9. Separate the control arm ball joint from the steering knuckle. Refer to *Lower Control Arm Replacement on page 15-9*.



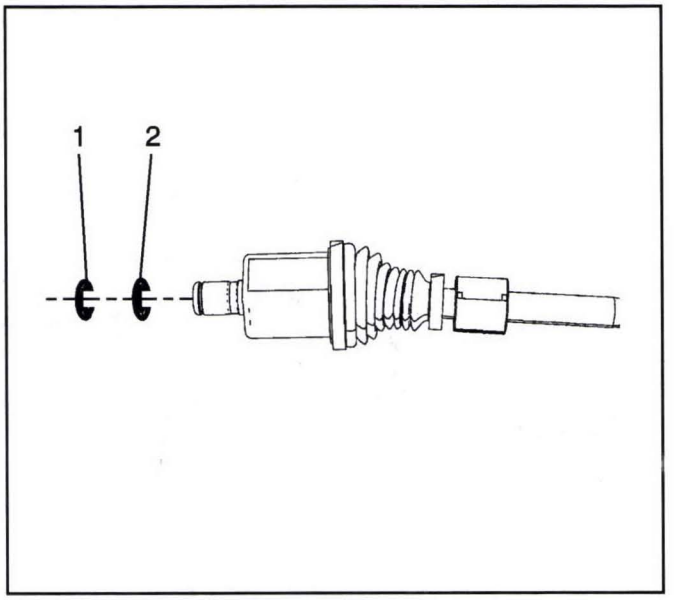
2327565

10. Using the *DT-50188* remover (2), separate the wheel drive shaft from the steering knuckle (1).



2027898

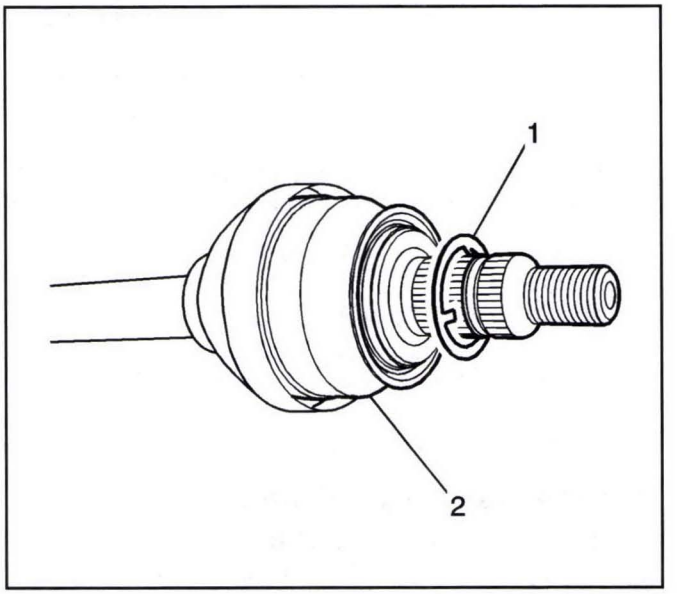
11. Using the *CH-313* hammer (2) with *CH-6003* remover remove the wheel drive shaft (3) from the vehicle.



3327093

Note: If there is no snap ring or O-ring on the wheel drive shaft, install a new snap ring and O-ring.

12. Remove and discard the snap ring (1) and O-ring (2) from the wheel drive shaft.

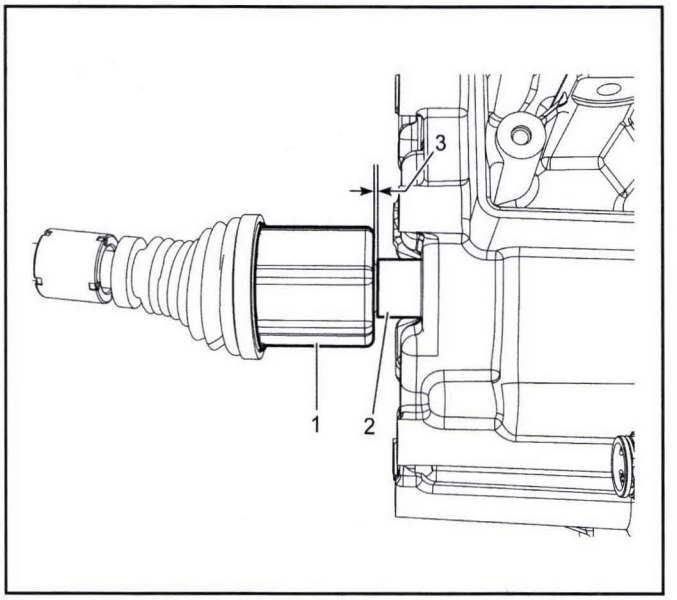


2318020

Note: If there is no washer on the wheel drive shaft , install a NEW washer.

13. Remove and discard the washer (1) from the wheel drive shaft (2). Do not re-use the washer , replace with NEW only.

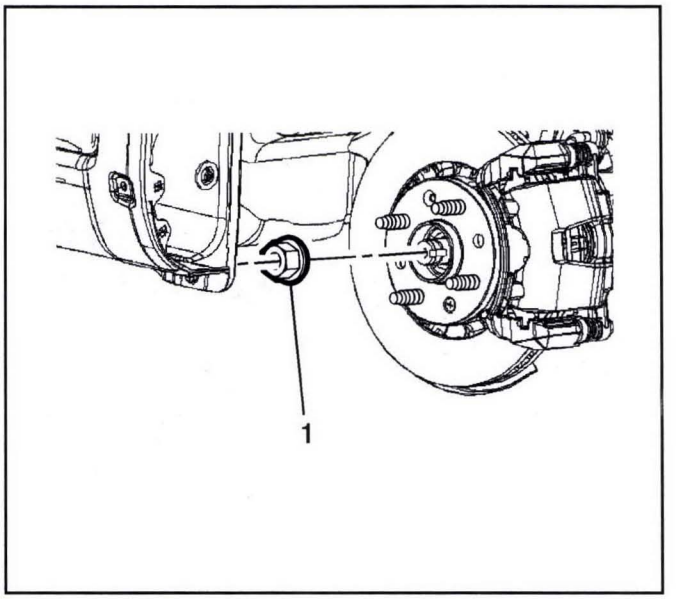
Installation Procedure



3671763

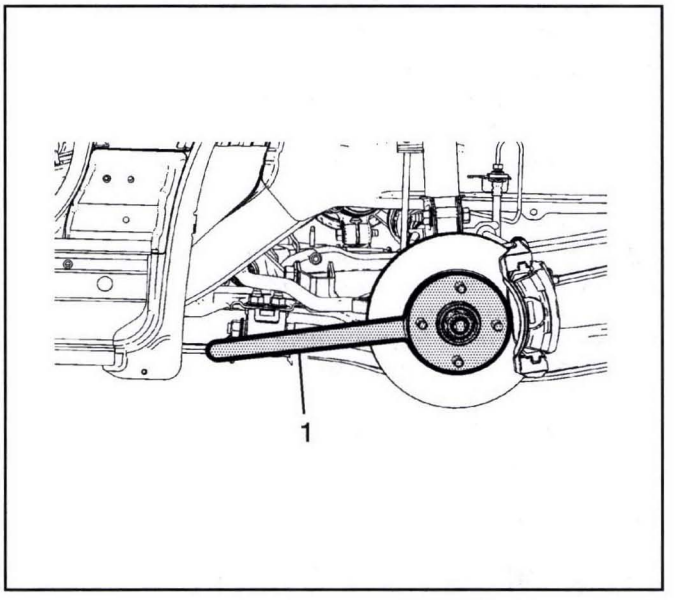
1. Install the inner tripod housing (1) until the wheel drive shaft splines are fully seated into the stub (2) extending from the transaxle.

   Note: Gap (3) between the inner tripod housing (1) and the stub (2) must be less than or equal to **3.7mm(0.148 in)** to prevent damage to the stub. In the following step, DO NOT pull on the wheel drive shaft. Pull only on the inner joint.
2. With the wheel drive shaft installed, grasp the inner tripod housing and pull the tripod outward to ensure that the wheel drive shaft is properly engaged. The wheel drive shaft will remain in place if properly installed.
3. Install the wheel drive shaft to the front wheel hub/ bearing.
4. Install the control arm ball joint to the steering knuckle. Refer to *Lower Control Arm Replacement on page 15-9*.
5. Install the outer tie rod assembly to the steering knuckle. Refer to *Steering Linkage Outer Tie Rod Replacement on page 14-14*.



3327121

6. Hand tighten the NEW wheel drive shaft nut (1) on the wheel drive shaft.

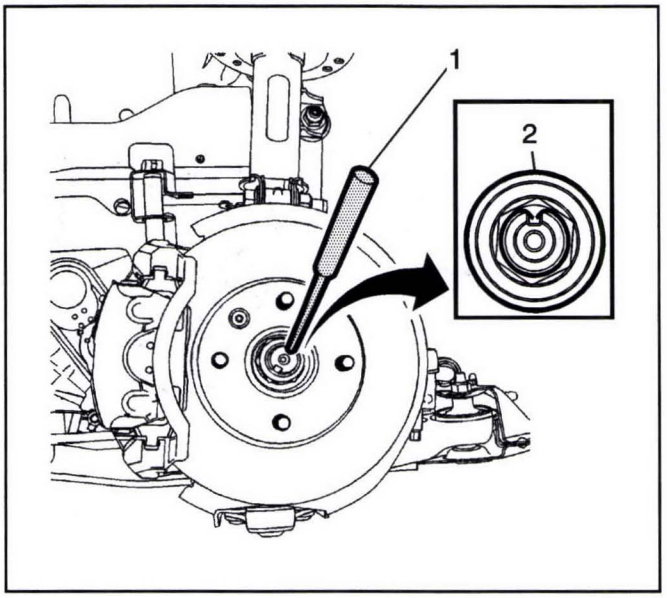


2965515

7. Install the *DT-50186* tool (1) to the wheel hub with two wheel nuts.
8. Support the *DT-50186* tool (1) outer end on a safety stand.

Caution: Refer to *Fastener Caution on page 0-8*.

9. Using a torque wrench and the appropriate size socket, install the wheel drive shaft nut and tighten to:.
   - First Pass 50 N.m (37 lb ft)
   - Final Pass plus 60 degrees
10. Remove the *DT-50186* tool (1) from the wheel hub.



3336229

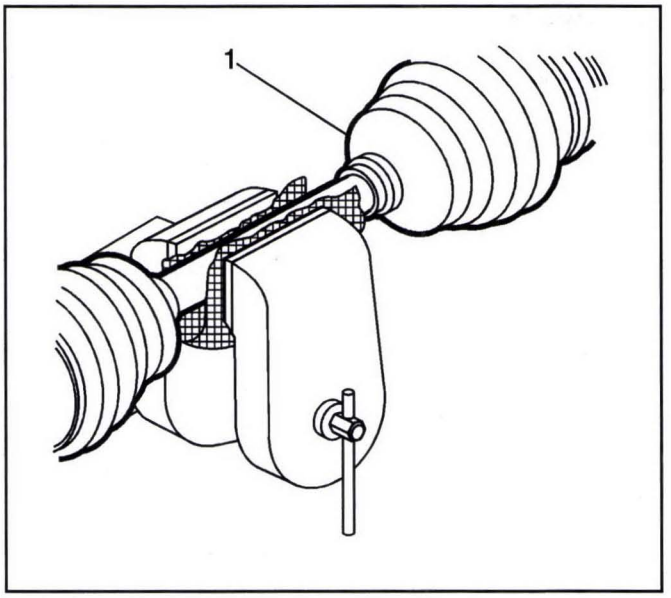
Note: Evenly split the center of the wheel drive shaft nut (2) and ensure that it is fully staked. Each side of the stake should be in contact and approximately 45 degrees to each side of the slot in the wheel drive shaft.

11. Using a punch (1) and the hammer , stake the wheel drive shaft nut (2) collar into the slot on the wheel drive shaft.
12. Install the wheel speed sensor into the knuckle. Refer to *Front Wheel Speed Sensor Replacement on page 5-84*.
13. Install the front compartment splash shield. Refer to *Front Compartment Splash Shield Replacement (Front) on page 3-119* or *Front Compartment Splash Shield Replacement (Middle) on page 3-120* or *Front Compartment Splash Shield Replacement (Rear) on page 3-121*.
14. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 15-51*.
15. Lower the vehicle.

Front Wheel Drive Shaft Inner Joint and Boot Replacement

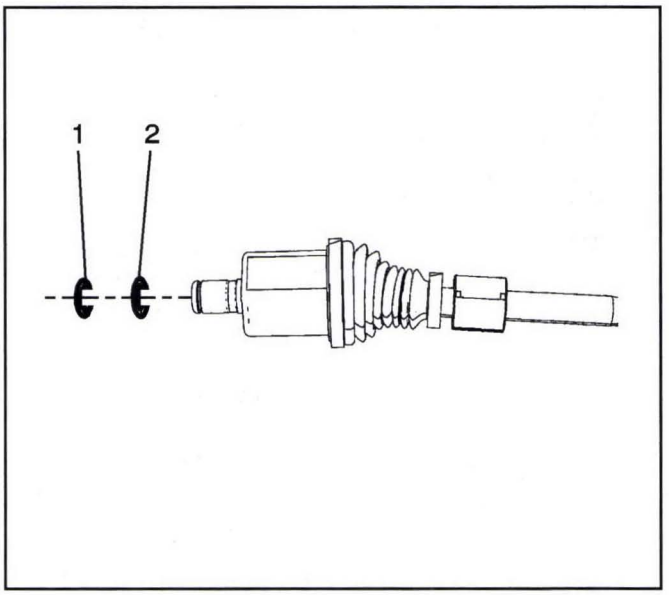
Disassemble Procedure

1. Remove the wheel drive shaft from the vehicle. Refer to *Front Wheel Drive Shaft Replacement - Left Side on page 7-4* or *Front Wheel Drive Shaft Replacement - Right Side on page 7-7*.



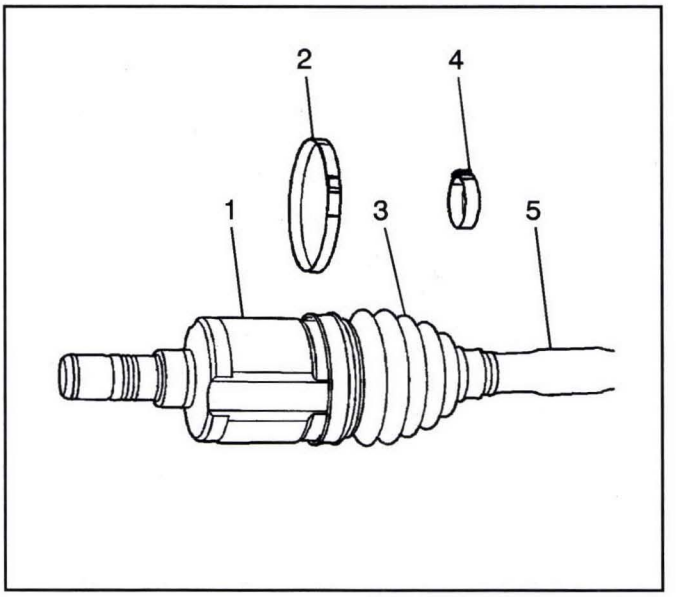
860858

2. Install the wheel drive shaft (1) in a soft jawed vise.



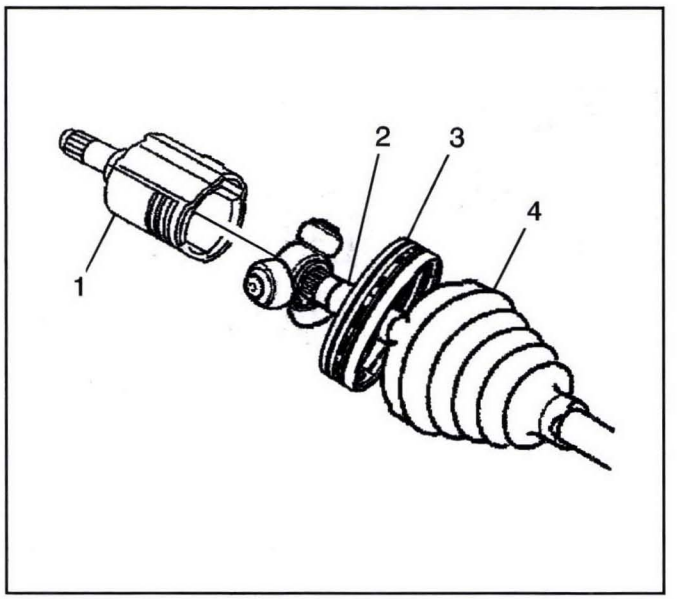
3327093

3. Remove and discard the snap ring (1) and O-ring (2) from the wheel drive shaft.



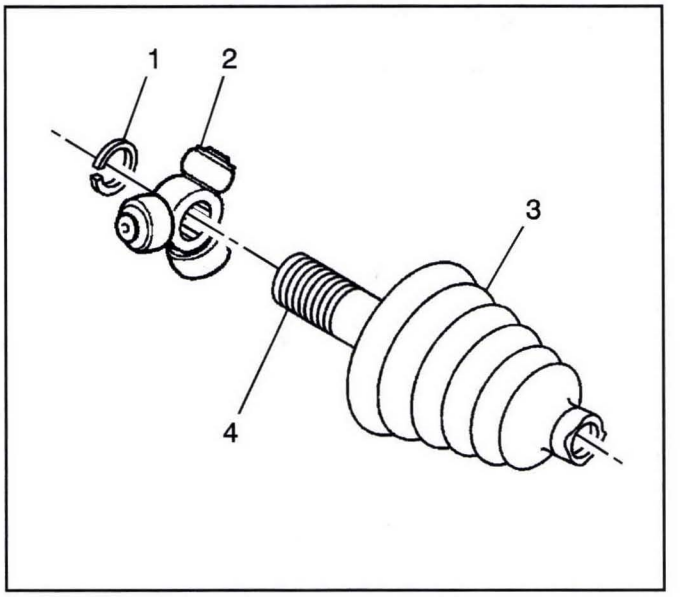
3327097

4. Using a pair of side cutters, remove and discard the small boot clamp (4) from the boot (3).
5. Using the appropriate tool, remove and discard the large boot clamp (2) from the boot (3).



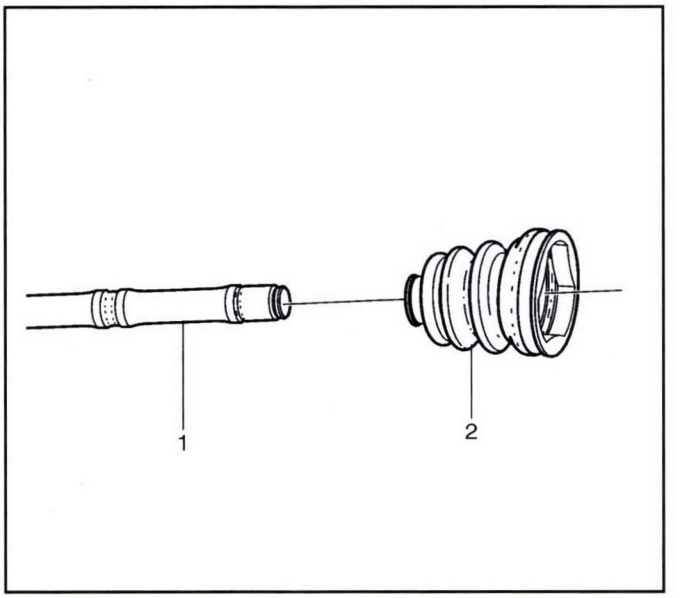
3327105

6. Remove the boot adapter (3) and the boot (4) from the tripot housing (1).
7. Using a brass punch and hammer, remove the inner tripot housing (1) from the wheel drive shaft (2).



3327113

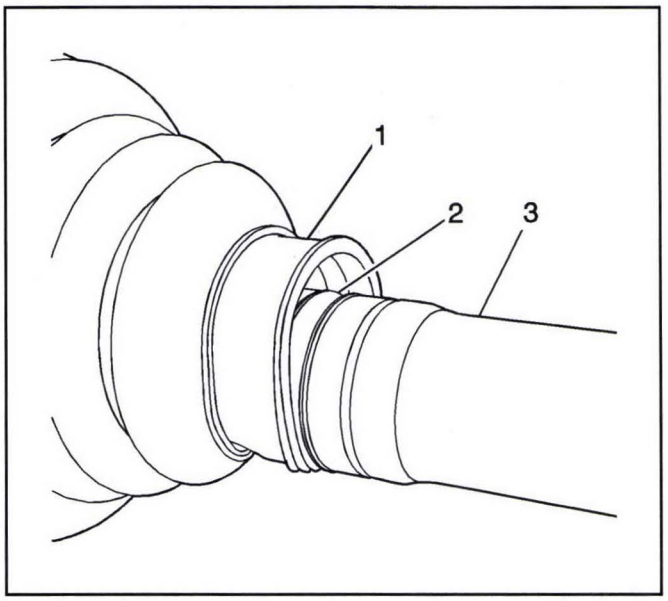
8. Using the appropriate tool , remove the outer tripot spider retaining ring (1) from the wheel drive shaft (4).
9. Remove the tripot spider (2) from the wheel drive shaft (4).



2327550

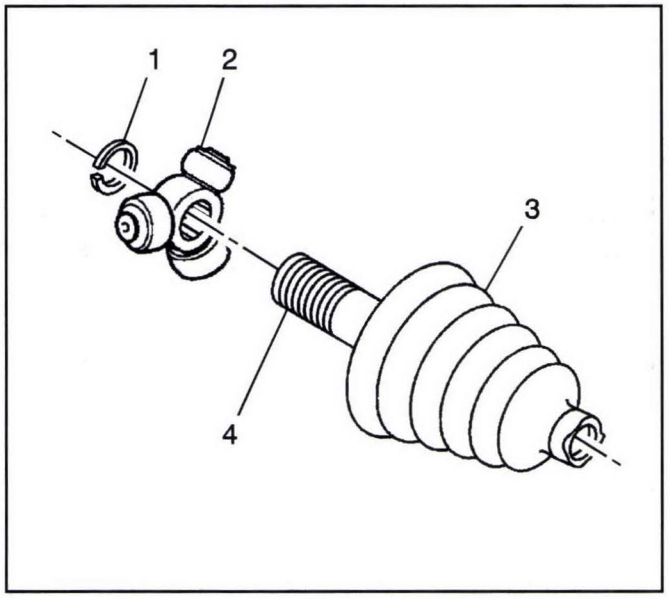
10. Remove the boot (2) from the wheel drive shaft (1).
11. Inspect the wheel drive shaft inner joint for damage and excessive wear. Refer to *Wheel Drive Shaft Inner Joint Inspection on page 7-16*.

Assemble Procedure



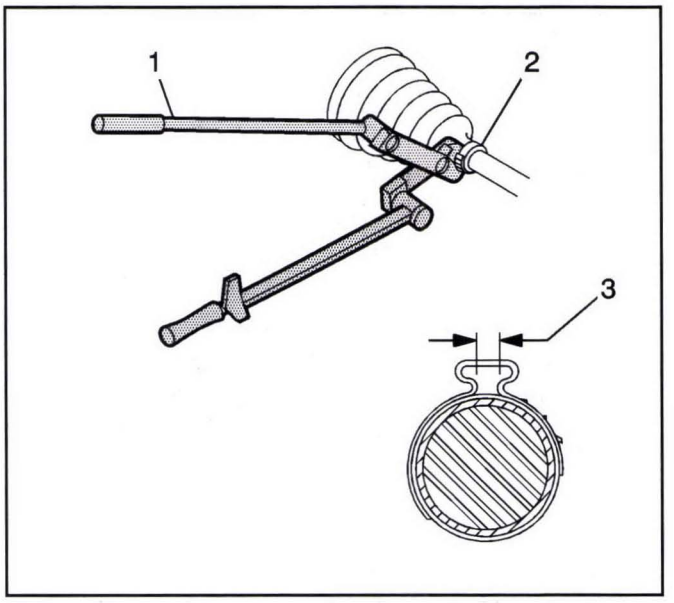
2008321

1. Install a new small boot clamp on the wheel drive shaft (3) do not crimp small clamp .
2. Install the boot (1) on the wheel drive shaft (3).
3. Ensure that the boot (1) is properly seated in the groove (2) in the wheel drive shaft.



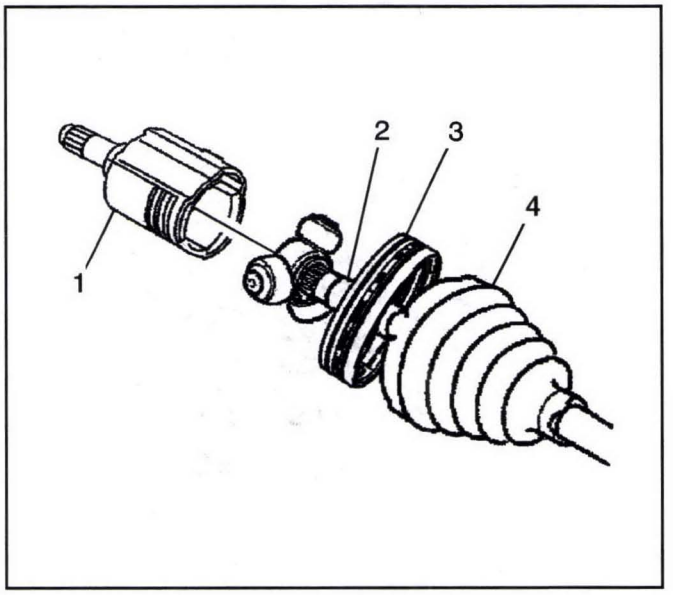
3327113

4. Install the tripot spider assembly (2) until it just touches the shoulder on the wheel drive shaft (4).
5. Using the appropriate tool, install the retaining ring (1) on to the wheel drive shaft (4).



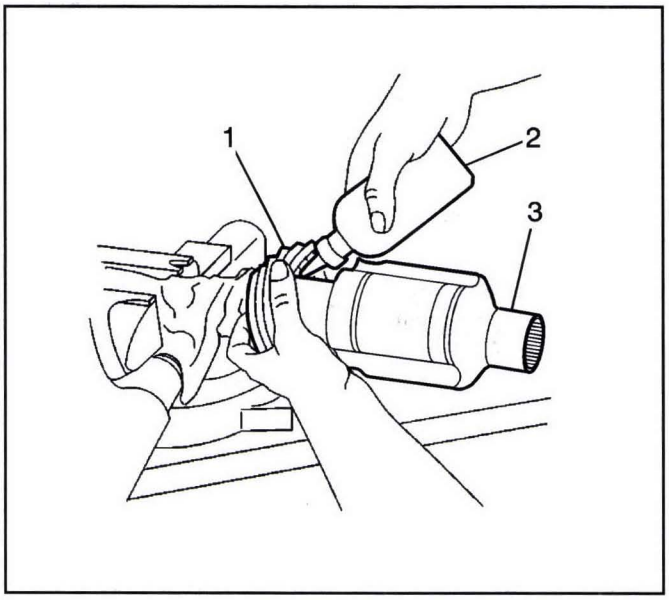
2087929

6. Using the DT-35910 pliers with a ratchet wrench and a breaker bar (1), close the New boot clamp (2) until the gap (3) measures 1.9 mm (0.07in) .



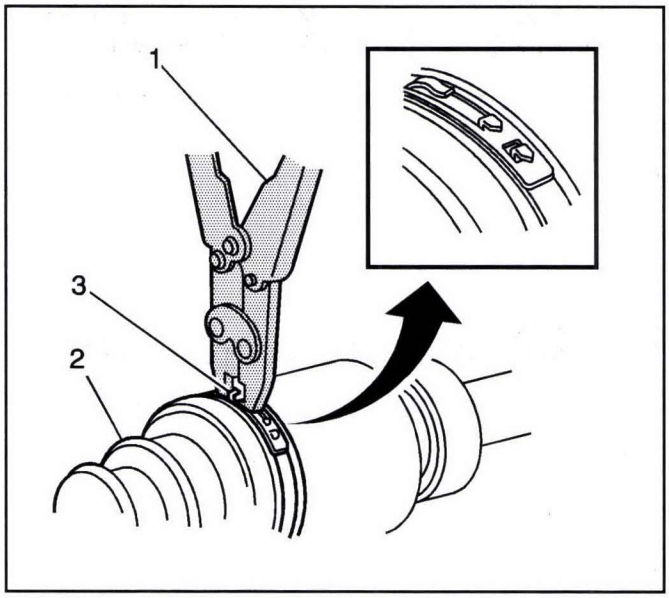
3327105

7. Install the tripot housing (1) on the wheel drive shaft (2) using a block of wood and a hammer.
8. Install the boot adapter (3) and the wheel drive shaft boot (4) on the tripot housing (1).



2058834

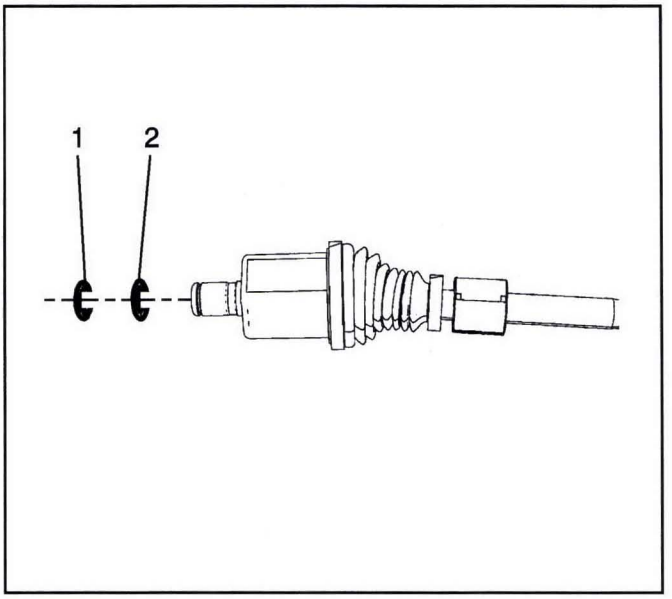
9. Place approximately half of the lubricant (2) in the boot (1) and the remaining half in the tripot housing (3).



1034498

Note: Ensure that the large boot clamp (3) is properly positioned around the entire circumference of the boot (2).

10. Using the *CH-48894* pliers (1) , close the NEW large boot clamp (3).
11. Remove any of the excess lubricant from the tripot housing and wheel drive shaft.
12. Move the tripot assembly in a circular motion 4 or 5 times to distribute the grease in the tripot assembly.



3327093

13. Install the New snap ring (1) and NEW O-ring (2) onto the wheel drive shaft.
14. Remove the wheel drive shaft from the vise.
15. Install the wheel drive shaft from the vehicle. Refer to *Front Wheel Drive Shaft Replacement - Left Side on page 7-4* or *Front Wheel Drive Shaft Replacement - Right Side on page 7-7*.

Front Wheel Drive Shaft Outer Joint and Boot Replacement

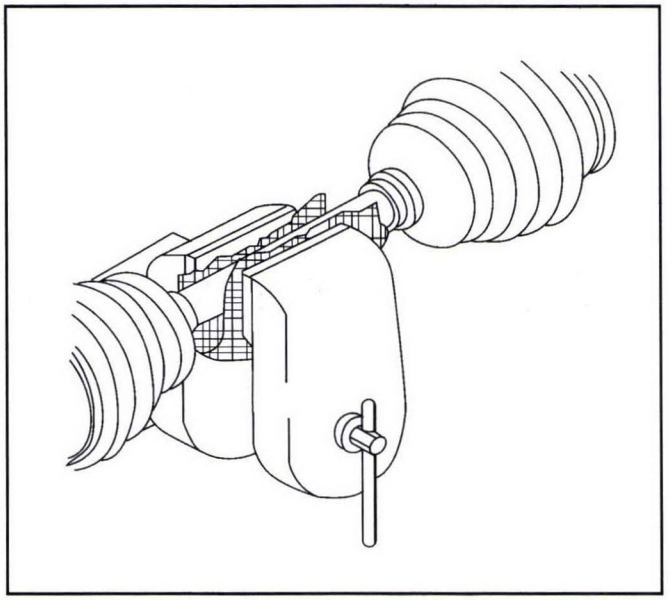
Special Tools

DT-35910 Drive Axle Boot Clamp Pliers

Note: Outer constant velocity joint and axle shaft cannot be separated and are replaced as a complete assembly.

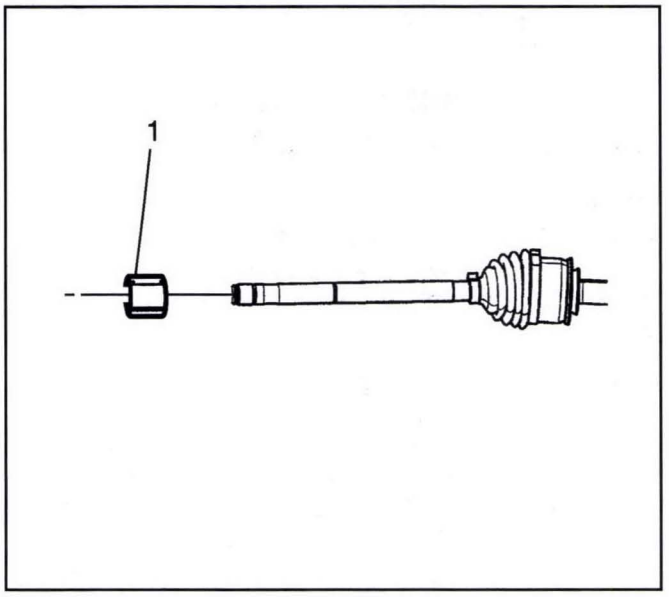
Disassemble Procedure

1. Remove the wheel drive shaft from the vehicle. Refer to *Front Wheel Drive Shaft Replacement - Left Side on page 7-4* or *Front Wheel Drive Shaft Replacement - Right Side on page 7-7*.



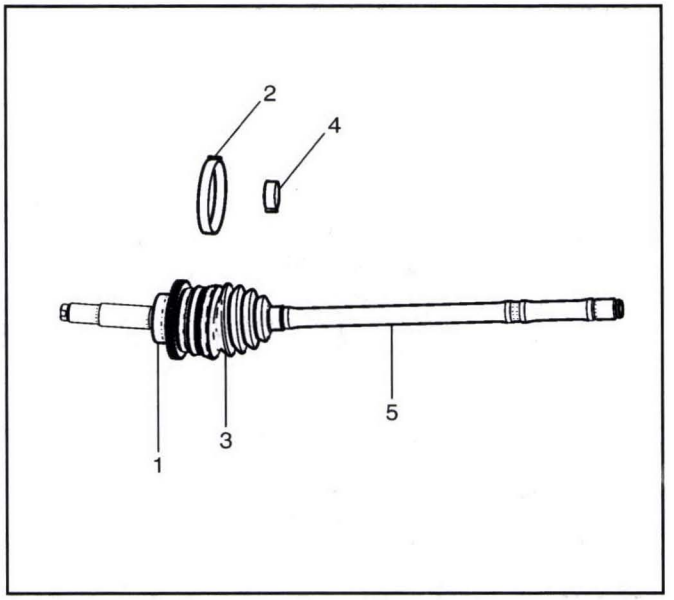
2327557

2. Clamp the drive axle shaft in a soft-jawed vice.
3. Remove the inner joint boot from the wheel drive shaft. Refer to *Front Wheel Drive Shaft Inner Joint and Boot Replacement on page 7-10*.



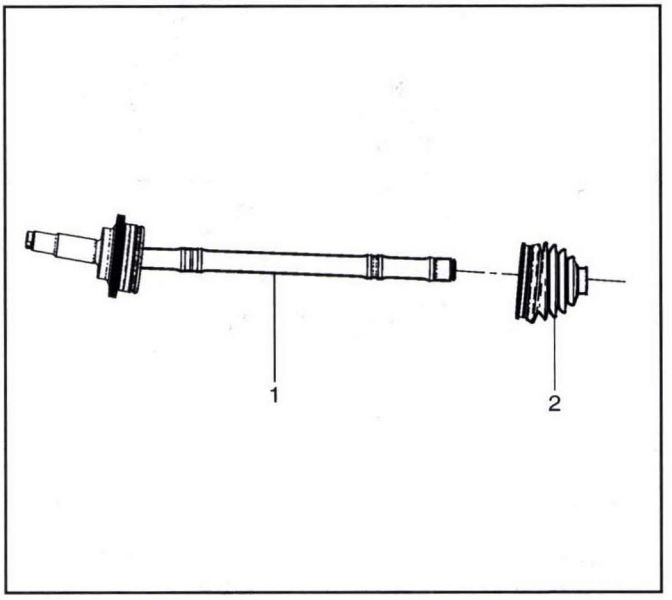
3327117

4. Remove the damper (1) from the wheel drive shaft.



2327548

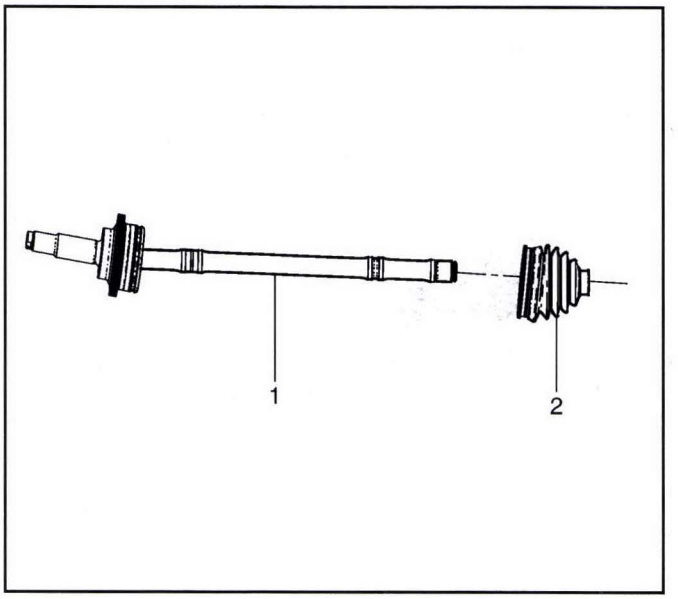
5. Using a flat-bladed tool, remove the boot retaining clamp (2) from the outer joint (1) and the boot (3). Discard the clamp.
6. Using a pair of side cutters, remove and discard the boot retaining clamp (4) from the boot (3) and the wheel drive shaft (5). Discard the clamp.



2327547

7. Slide the boot toward the inner joint and remove the boot (2) from the wheel drive shaft (1).

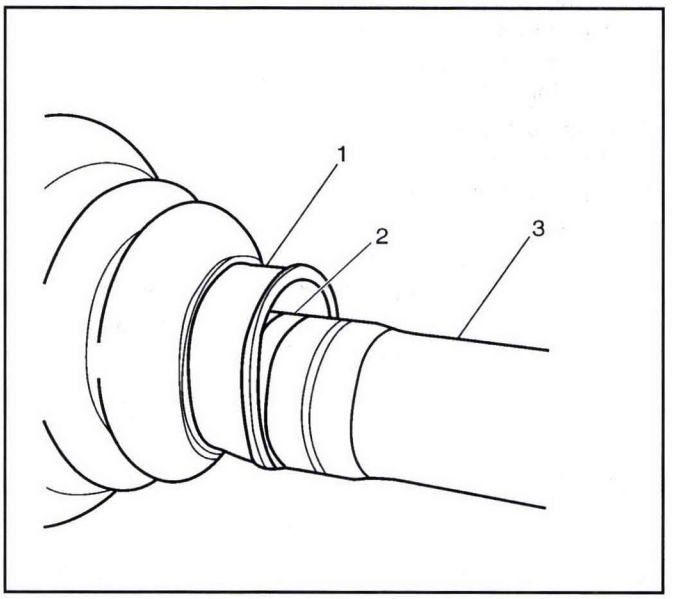
Assemble Procedure



2327547

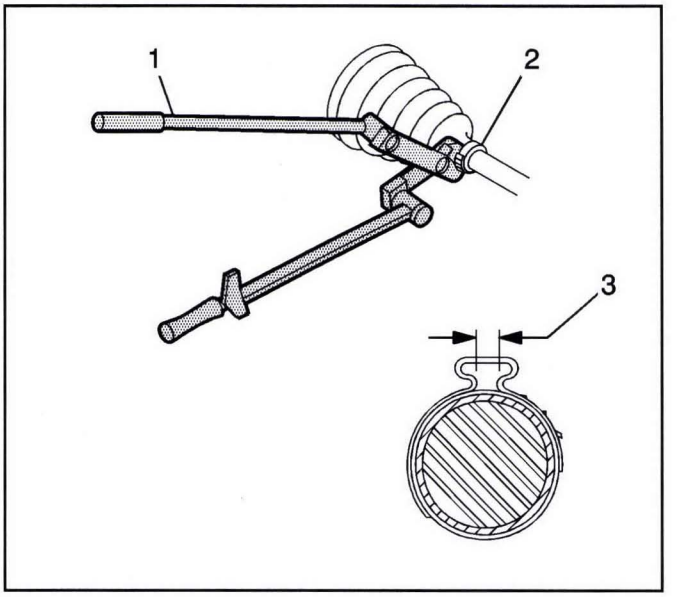
Note: Ensure the seal clamp is positioned correctly in the seal groove.

1. Position the boot (2) on the wheel drive shaft (1).



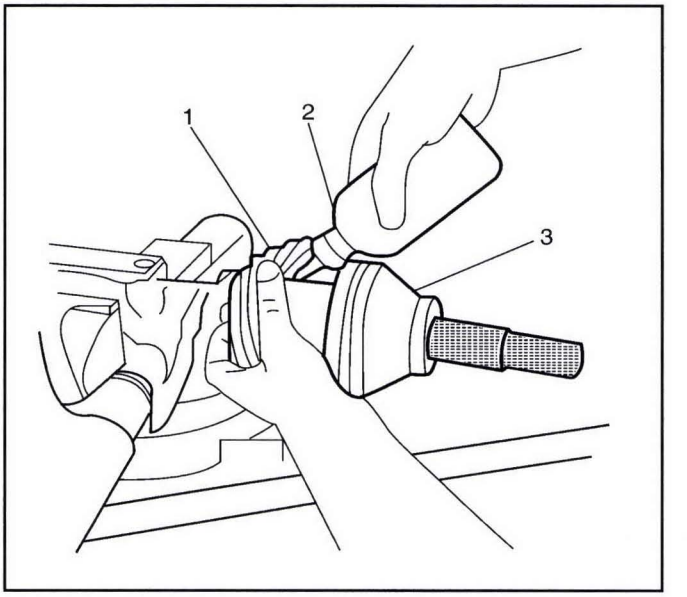
2327546

2. Ensure that the boot (1) is properly seated in the groove (2) in the wheel drive shaft (3).



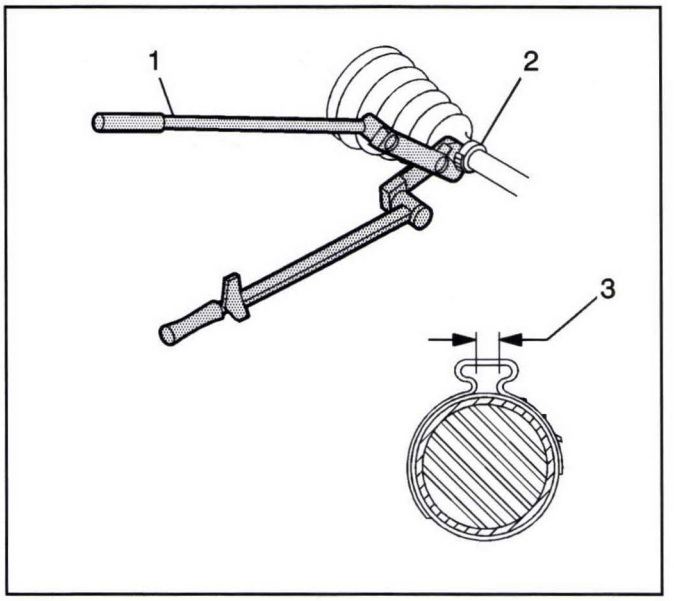
2087929

3. Using the *DT-35910* pliers and a torque or ratchet wrench and breaker bar (2), close the small boot clamp (2) until the gap (3) measures 1.90 mm (0.07 in).



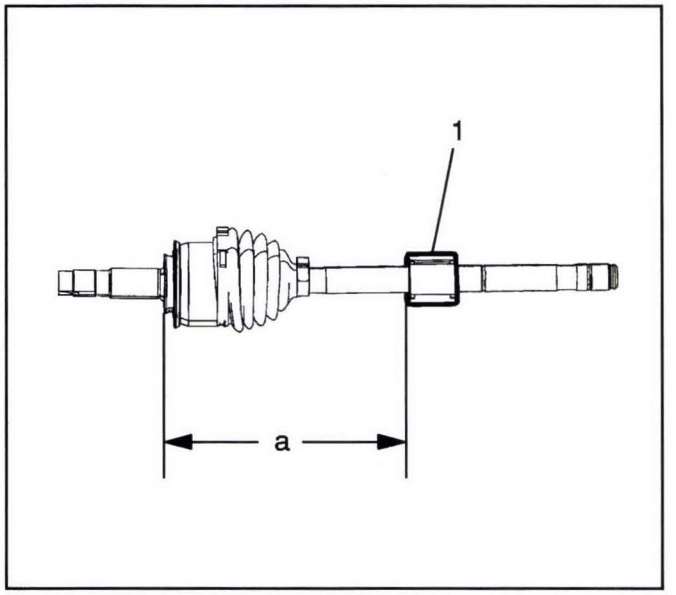
2327544

4. Place approximately half the lubricant (2) inside the outer joint boot (1) and the other half in the outer joint (3)



2087929

5. Using the *DT-35910* pliers and a torque or ratchet wrench and breaker bar (2), close the small boot clamp (2) until the gap (3) measures 1.70 mm (0.06 in).

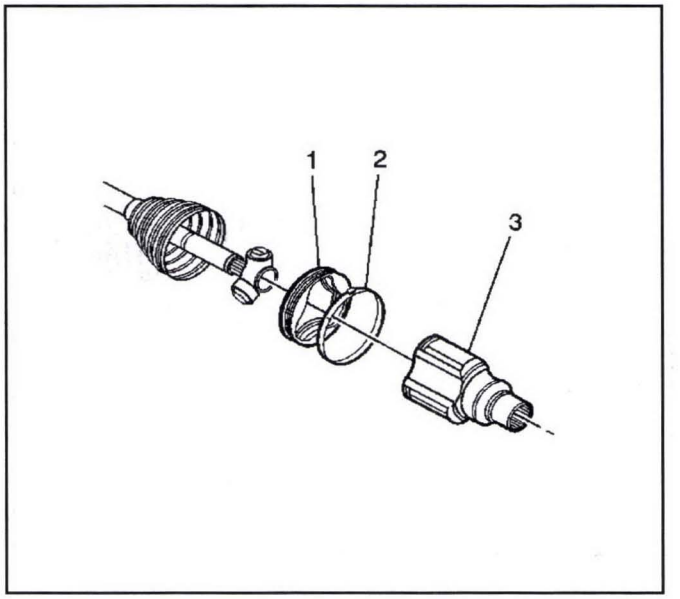


3327116

Note: Make sure that the distance (A) between outboard joint back-face and damper is approximately 216mm (8.5 in)

6. Install the damper (1) to the wheel drive shaft.
7. Install the inner joint boot onto the wheel drive shaft. Refer to *Front Wheel Drive Shaft Inner Joint and Boot Replacement on page 7-10*.
8. Remove the wheel drive shaft from the bench vise.
9. Move the outer joint in a circular motion 4 to 5 times to distribute the lubricant.
10. Install the wheel drive shaft in the vehicle. Refer to *Front Wheel Drive Shaft Replacement - Left Side on page 7-4* or *Front Wheel Drive Shaft Replacement - Right Side on page 7-7*.

Wheel Drive Shaft Inner Joint Inspection



2327543

1. Remove the wheel drive shaft tripod bushing clamp (2) from the tripod housing (3).
2. Remove the wheel drive shaft tripod housing (3) from the wheel drive shaft.
3. Remove the wheel drive shaft tripod joint boot bushing (1).
4. Using a suitable cleaner, remove the excess grease from the tripod assembly.
5. Inspect the following items for damage or excessive wear:
   - The wheel drive shaft tripod boot
   - The wheel drive shaft tripod assembly
   - The wheel drive shaft tripod joint housing
   - The wheel drive shaft
6. If any of the items in step 5 are found to be defective, replace those items that are serviceable.

Description and Operation

Wheel Drive Shafts Description and Operation

Wheel drive shafts are flexible assemblies consisting of an inner tripod joint and an outer constant velocity joint connected by an axle shaft. The inner joint is completely flexible, and can plunge in and out. The outer joint is also flexible, but cannot plunge in and out. These drive axles are used to transmit rotational force from the transaxle to the front tire and wheel assemblies.

Seal and Clamp

The wheel drive shafts use inboard and outboard joint seals made of thermoplastic material, and clamps made of stainless steel. The functions of the seals are as follows:

- The seals protect the internal parts of the inboard and outboard joints.
  - They protect the joint lubricating grease from surrounding detrimental atmospheric conditions, such as extreme temperatures, ozone gas, etc.
  - They protect the joint lubricating grease from foreign materials, such as stones, dirt, water, salt, etc.
- The seals facilitate angular and axial movement of the inboard joint.
- The seals facilitate angular movement of the outboard joint.

The function of the clamps is as follows:

- Provide a leak proof connection at both the housing and the axle shaft for the inboard and outboard joints.
- The thermoplastic material performs well against normal handing, operational wear, and conditions. This material however, is not strong enough to withstand abusive handling or damage due to objects such as sharp tools or the sharp edge of any other surrounding component on the vehicle.

Inner Joint

The inner joints are of the tripod design without an over-extension limitation retainer. The inner joints incorporate a male spline which interlocks with the transaxle, or the intermediate drive shaft if equipped, using snap rings.

Outer Joint

The outer joints are of the Rzeppa, constant velocity joint design. The shaft end which mates with the wheel bearing and hub assembly, incorporates a spline.

Special Tools and Equipment

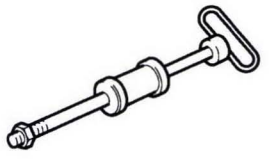
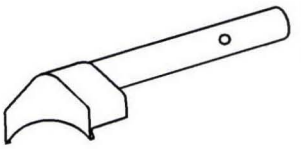
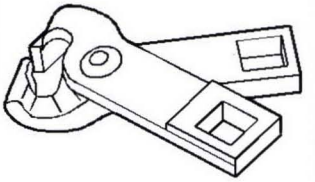
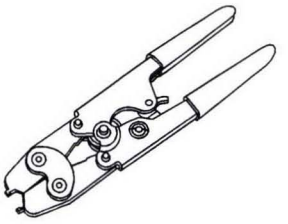
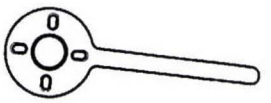
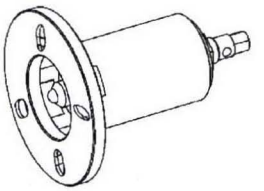
Illustration	Tool Number/ Description
 2028181	DT-313 GE-313 GE-6125–1B KM-313 Slide Hammer

Illustration	Tool Number/ Description
 1936272	CH-6003 KM-6003 J-33008–A Axle Shaft Remover
 5625	DT-35910 CH-804 Drive Axle Boot Clamp Pliers
 2035367	CH-48894 DT-50185 Wheel Drive Shaft Boot Clamp Pliers
 2329961	DT-50186 Wheel Hub Holding Tool
 2336215	DT-50188 CH-45859 Hub Spindle Remover

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